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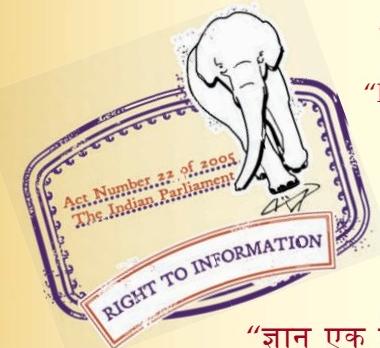
“Step Out From the Old to the New”

IS 8270-4 (1977): Guide for preparation of diagrams, charts and tables for electrotechnology, Part 4: Circuit diagrams [ETD 1: Basic Electrotechnical Standards]

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Bhartṛhari—Nītiśatakam

“Knowledge is such a treasure which cannot be stolen”



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Indian Standard
GUIDE FOR PREPARATION OF
DIAGRAMS, CHARTS AND TABLES FOR
ELECTROTECHNOLOGY

PART IV CIRCUIT DIAGRAMS

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Indian Standard

GUIDE FOR PREPARATION OF DIAGRAMS, CHARTS AND TABLES FOR ELECTROTECHNOLOGY

PART IV CIRCUIT DIAGRAMS

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Indian Standard

GUIDE FOR PREPARATION OF DIAGRAMS, CHARTS AND TABLES FOR ELECTROTECHNOLOGY

PART IV CIRCUIT DIAGRAMS

0. FOREWORD

0.1 This Indian Standard (Part IV) was adopted by the Indian Standards Institution on 30 November 1977, after the draft finalized by the Electrotechnical Standards Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 A number of standards have been published on graphical symbols for use on diagrams in the field of electrotechnology (*see* various parts of IS : 2032*). After having covered most of the needs for graphical symbols, with the exception of those for new fields of electrotechnology, still under consideration, it has been found advisable to supplement the standards on symbols with standards for the preparation of diagrams.

0.3 This standard includes definitions and classification of diagrams, charts and tables; guiding principles for: (a) use and combination of graphical symbols; (b) for preparation of diagrams; (c) for supplementing or replacing diagrams by charts and tables; item designation; etc.

0.4 This standard is being brought out in five parts as follows:

Part I Definitions and classification

Part II Item designation

Part III General requirements for diagrams

Part IV Circuit diagrams

Part V Interconnection diagrams and tables

0.5 This standard has been prepared to lay down rules for the preparation of diagrams for proper functioning of the equipment or part of it, if necessary with the aid of description as supplementary information, for example, charts and tables.

0.6 While preparing this standard, considerable assistance has been derived from IEC Pub 113-4 (1975) 'Diagrams, charts, tables : Part IV Recommendations for the preparation of circuit diagrams', issued by the International Electrotechnical Commission.

1. SCOPE

1.1 This standard (Part IV) provides guidance for preparation of circuit diagrams used in electrotechnology.

NOTE — This standard does not deal with rules for markings of apparatus terminals. The markings shown in certain figures are only examples.

2. PURPOSE OF A CIRCUIT DIAGRAM

2.1 A circuit diagram should:

- a) explain the functioning of the equipment or part of it, if necessary with the aid of a description or supplementary information, for example, charts and tables;
- b) provide data for the preparation of wiring diagrams or tables (in conjunction with constructional design information when necessary);

NOTE — Wiring information may be given on a circuit diagram but not to such an extent that the purpose in (a) above is difficult to fulfil.

c) and facilitate testing and fault location. Additional documents, such as handbooks, wiring or location diagrams or tables may be required.

3. CONTENTS OF A CIRCUIT DIAGRAM

3.1 A circuit diagram should show, by means of graphical symbols, the electrical connections and functions of a specific circuit arrangement without regard to the actual physical size, shape or location of the parts. The diagram should facilitate tracing the circuit and its functions.

3.1.1 Simplifications are permissible in the following cases:

- a) Single-line representation of the whole circuit or part of it may be used, if it is sufficient for the defined purpose;
- b) Part of the circuit diagram may be replaced by block symbols or rectangles to save space or to improve clarity. In such cases reference may be made to diagrams giving more detailed information of the circuits represented by the block symbols or rectangles;

*Graphical symbols used in electrotechnology.

- c) When a particular circuit arrangement is repeated, it may be sufficient to show this circuit arrangement once only in detail with appropriate references replacing the other circuits; and
- d) If external or common circuits are necessary for the understanding of the circuits concerned, they may be shown in simplified form with a reference to the relevant complete diagram.

4. GENERAL GUIDING PRINCIPLES

4.1 Layout — The most important consideration in the preparation of a circuit diagram is the adoption of a clear layout which best aids understanding and fulfils the purposes described in 2.

Lines representing conductors on a diagram should be straight with a minimum of cross-overs and changes of direction. Individual circuits should preferably be arranged vertically as shown in Fig. 1 or horizontally as shown in Fig. 2.

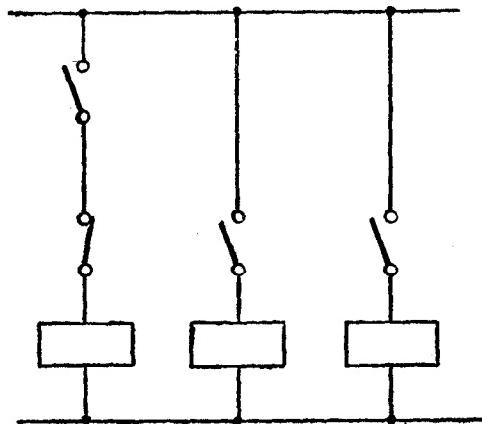


FIG. 1 VERTICALLY ARRANGED CIRCUIT

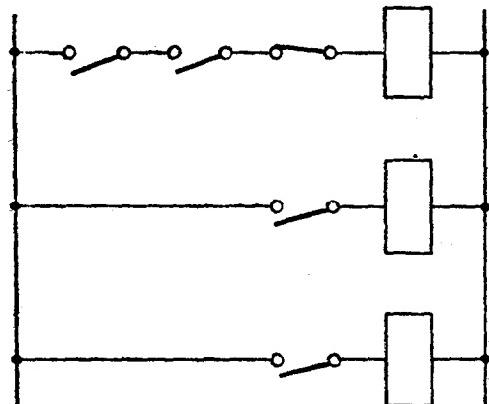


FIG. 2 HORIZONTALLY ARRANGED CIRCUIT

In Fig. 1 to 36, T-junctions are shown without a dot. In accordance with IS : 2032*, it is equally

*Graphical symbols used in electrotechnology (Parts I to XVIII).

permissible to draw T-junctions with a dot or a circle. One of the three methods should be used consistently in each diagram or set of diagrams.

4.2 Functional Grouping — It is recommended that symbols for circuit elements performing a basic function, not necessarily in the same constructional unit, be grouped together (see 6.6). Whenever possible, functional groups should be arranged so that the sequence of events or signal flow are clear with other elements also arranged to serve this purpose. Circuits should preferably be drawn so that this sequence is shown from left to right or from top to bottom.

5. ARRANGEMENT OF SYMBOLS ON DIAGRAMS

5.1 Methods for Indicating Symbol Location

5.1.1 Zonal Reference System — The zonal reference system is described in IS : 8270 (Part III)-1977*.

Examples:

Fig. 38, using references with sheet numbers and row designations.

Fig. 39, using references with column designations.

Fig. 43A and 44, using references with rectangular zone designations.

5.1.2 Tabular System — Along a horizontal edge of the drawing, the item designations are repeated above or below the corresponding symbols. These item designations are usually arranged in rows, for example, a row for capacitors, a row for resistors, etc (see Fig. 47). A similar vertical arrangement is also permissible.

5.1.3 Circuit Reference System — Circuits such as shown in Fig. 1 and 2 may be identified by circuit numbers (see Fig. 40).

5.2 Methods of Circuit Representation — The following methods of representation are defined in IS : 8270 (Part I) - 1976†.

- a) Assembled representation,
- b) Semi-assembled representation, and
- c) Detached representation.

5.2.1 Assembled Representation — In simple diagrams, it may be satisfactory to show the symbols for the parts of multi-part components such as relays, keys, switches, etc, in close proximity (see Fig. 3).

5.2.2 Semi-assembled Representation — Semi-assembled representation with straight mechanical linkage symbols, for example, (see Fig. 37) may result in bends of circuit lines and crossing of lines, which considerably reduces the clarity of the circuit representation.

*Guide for preparation of diagrams, charts and tables for electrotechnology: Part III General requirements for diagrams.

†Guide for preparation of diagrams, charts and tables for electrotechnology: Part I Definitions and classification.

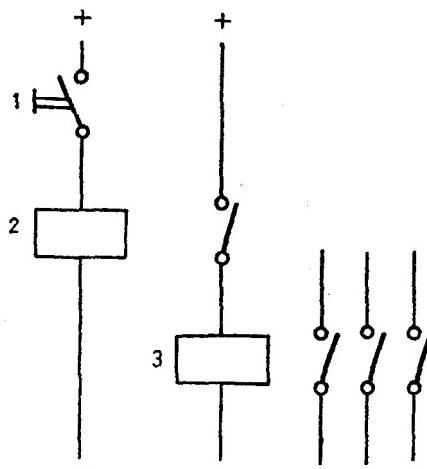


FIG. 3 ASSEMBLED REPRESENTATION

To clarify the diagram, it may be necessary to allow crossings, bends and branching of linkage lines (see Fig. 14 and Fig. 38).

5.2.3 Detached Representation — Detached representation (see Fig. 39) leads to a considerable simplification of drawings, but introduces the problem of indicating which parts belong to the same component. Some recommended methods are described in 5.4.

5.3 Separation of Symbols in Detached Representation — When detached representation is used, the symbols for the parts of a multi-part component will usually be spread over the circuit diagram.

Symbols for relays, manually operated switches, etc., are provided, where necessary, with qualifying symbols to describe the operation, for example, symbols denoting polarization, delay, automatic reset, etc.

The same amount of information should be given in diagrams where detached representation is used. In principle, therefore, the qualifying symbol should be shown associated with each symbol part concerned.

Table 1 shows some examples of how this may be done.

5.4 Methods of Referencing Parts in the Case of Detached Representation — On a diagram in detached representation, the symbol for each part shall be referenced so that:

- it may be seen without ambiguity that all the various parts of any given component in fact belong to that, and
- the location of any given symbol on the diagram may easily be found.

This information may be given by:

- inset diagrams, or
- tables.

If it is not possible to place the inset diagrams or tables in line with the corresponding circuits, they

may be located elsewhere on the diagram or on a separate sheet. In this case, they should be supplemented by an indication of the location of the operating device.

NOTE — Such references may not be necessary in certain simple cases where the addition of the mechanical linkage symbol is sufficient. For example, see switch S-1 in Fig. 39.

5.4.1 Inset Diagrams — Figure 39 gives an example of this method. For each contactor or relay, an inset diagram showing all its coils and contacts, is shown below the circuit which contains the coil. For example, in column 7, the diagram for contactor +A4-K1 appears below the symbol for its coil. The reference at the left of a contact symbol indicates the column where the contact is shown in a circuit. Thus the symbol for contact with terminal markings 21-22 is to be found in column 8 of the diagram.

Similarly for each contact shown in the circuit diagram a reference to the position of the coil is given. For example, for contact +A2-K3, shown in a circuit near the top of column 6, the reference 5 indicates that coil +A2-K3 can be found in column 5.

Figure 44 is an example, where all inset diagrams are placed together to the right on the drawing and shown in topographical representation. Topographical representation may be specially suitable for components with complicated contact units where there is no space for terminal markings. The arrangement of the terminals is shown in this example as seen from the wiring side.

Another method of indicating the location of symbols for multi-part components is by inset diagrams as shown in Fig. 43B and 43C.

5.4.2 Representation by Table — The inset diagrams may be replaced by tables giving the same information. For relays, contactors, etc, Tables 2A and 2B are typical and apply to contactor +A4-K1 in Fig. 39.

If there are terminal markings on the component or if they are known by convention, they should be shown in the table. In other cases, an arbitrary identification, for example, a dot, should be used in the table.

5.5 Representation of Unused Elements — On the final diagrams, prepared after design and development, unused elements, for example, contacts, windings and terminals should be shown or referenced.

In semi-assembled representation, the unused elements shown should be linked with the other elements of the same multi-part component, for example, the unused contacts of a relay on the broken line representing the mechanical coupling (see, for example, Fig. 37).

When detached representation as described in 5.4 is used, the absence of a reference in the inset diagram or table denotes that the element is not used in the equipment. For example, see Fig. 39

TABLE 1 SEPARATION OF SYMBOLS IN DETACHED REPRESENTATION

(Clause 5.3)

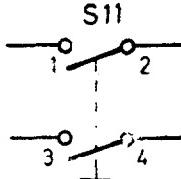
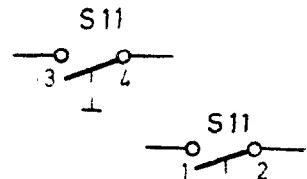
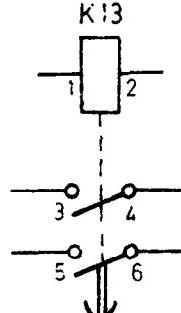
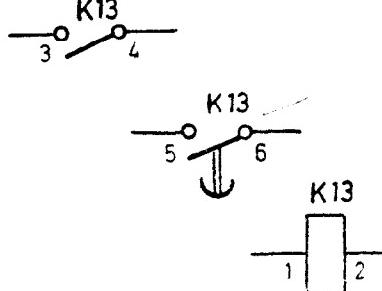
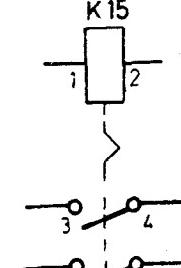
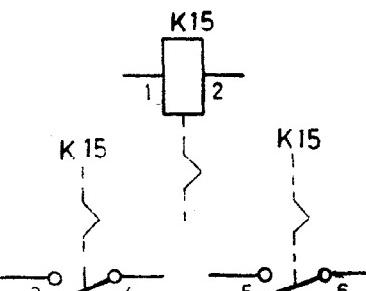
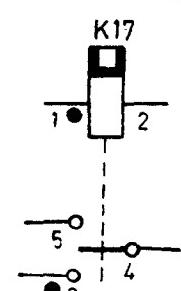
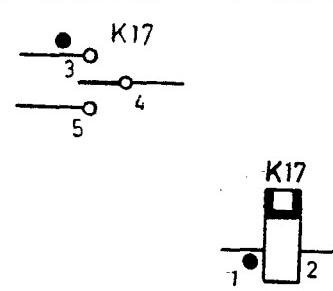
No.	ASSEMBLED REPRESENTATION	DETACHED REPRESENTATION
1	 S11	 S11
2	 K13	 K13
3	 K15	 K15
4	 K17	 K17

TABLE 2A METHOD OF REFERENCING PARTS IN DETACHED REPRESENTATION
(Clauses 5.4.2 and 5.5)

MAKE CONTACT	BREAK CONTACT	COLUMN
1-2		3
3-4		3
5-6		3
13-14		7
23-24	21-22	8

NOTE — Symbols may be used, instead of words, for column headings (see Fig. 40).

TABLE 2B ALTERNATE METHOD OF REFERENCING PARTS IN DETACHED REPRESENTATION
(Clauses 5.4.2 and 5.5)

SL NO.	CONTACT PARTICULARS	TYPE OF CONTACT	COLUMN NUMBER
1	1-2	Make	3
2	3-4	Make	3
3	5-6	Make	3
4	13-14	Make	7
5	21-22	Break	8
6	23-24	Make	—

and Tables 2A and 2B, contact 23-24 of contactor +A4-K1.

5.6 Representation of Contacts — Wherever practicable, consistent orientation of contact symbols for relays, contactors, etc, is recommended. When using detached representation in circuits with complicated contact arrangements, a clear layout of the diagram without crossings has preference over consistency in contact symbol orientation.

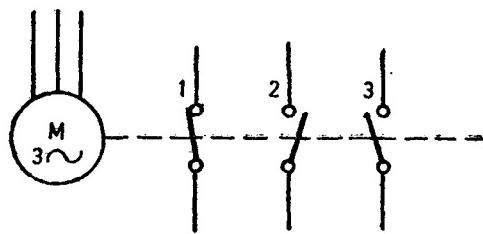
All contact symbols shown on one mechanical linkage symbol should have the same direction of movement when actuated by the same actuating device.

For contacts which are neither electrically nor manually operated, it is necessary that the circuit diagram should contain an indication of the means of operation. The contact symbol should be drawn in a position consistent with that indication.

The indication adjacent to a symbol may consist of the following:

- A graph : Examples of graphs are given in the left hand column of Table 3 : 0 on the vertical axis stands for 'contact open' and 1 for 'contact closed'.
- A symbol for the operating device : For cam-operated devices (chosen as an example of operating devices), the symbols shown in the right hand column of Table 3 may be used.
- A note, designation or table : A short text such as shown in Fig. 4 may be suitable in some cases.

Example: Motor equipped with centrifugal switch.



1 — closed in start position, otherwise open
2 — closed at $100 < n < 200$ r/min
3 — open at high speed, otherwise closed.

FIG. 4 MOTOR EQUIPPED WITH CENTRIFUGAL SWITCH

6. REPRESENTATION OF CIRCUITS

6.1 General — The general principles given in 4 apply to representation of circuits.

6.2 Representation of Supply — The supply may be represented by:

- lines as shown in Fig. 1 and 2;
- symbols such as +, —, ~, etc, as shown in Fig. 5; or
- a combination of both (see Fig. 6).

The arrangement of dc circuits and single-phase circuits on the diagram is made easier and clearer by placing the circuits between supply lines.

In multi-phase circuits, all the supply lines may be shown together to one side, or above or below the circuit.

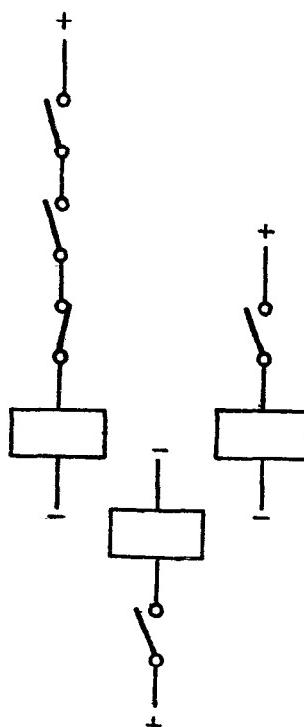
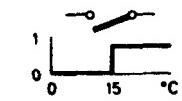
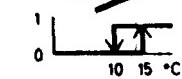
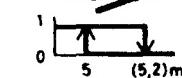
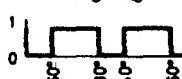
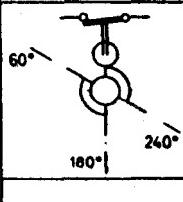
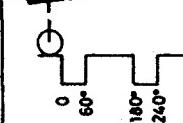
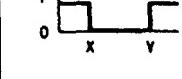
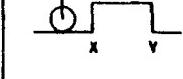
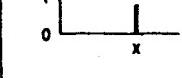
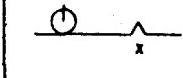
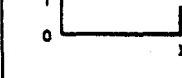
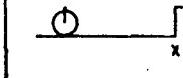
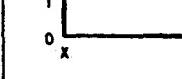
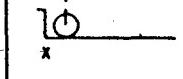


FIG. 5 REPRESENTATION OF SUPPLY BY SYMBOLS

TABLE 3 EXAMPLES OF GRAPHICAL INDICATION
(Clause 5.6)

Example	Description in circuit diagram:		Explanation
	by graph	by cam symbol	
1			Contact closed at temperatures equal to or exceeding 15 °C
2			Contact closes when temperature increases to 15 °C and then opens when temperature decreases to 10 °C
3			If it is desirable to show that the reset value is only of secondary interest, the reset value is shown in brackets: contact closes when speed decreases to 5 m/s and opens when speed increases to about 5.2 m/s
4	 		Contact closed between 60° and 180° and also between 240° and 360 (0°), otherwise opened
5			Contact opened between position X and position Y, otherwise closed
6			Contact closed only when passing position X
7			Contact closed only in end position X
8			Contact opened only in end position X

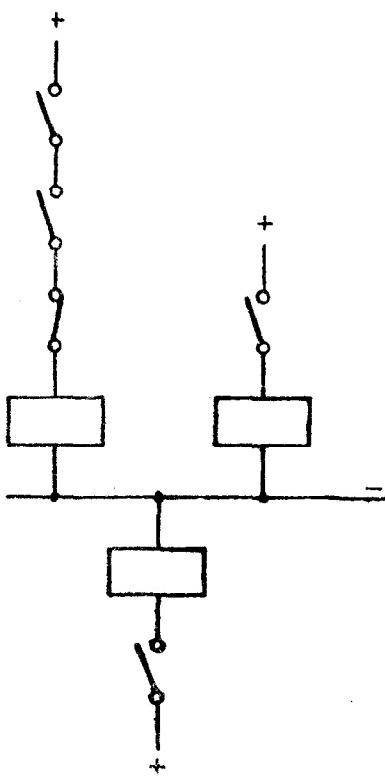


FIG. 6 REPRESENTATION OF SUPPLY BY COMBINATION OF LINES AND SYMBOLS

Symbols for the conductors of three-phase systems should preferably be shown in conventional phase sequence order, starting from the top or from the left of the diagram. Neutral conductors should be shown below or to the right of the phase conductors.

6.3 Representation of Main Circuits — A circuit diagram for the control equipment of a power plant or an industrial plant should also show the main power circuits to such an extent that the study of the function of the control equipment is facilitated. It may often be sufficient to show the main circuits or part of them in single-line representation. In certain cases, however, it may be necessary to use multi-line representation, for example, to show how measuring transformers are connected.

6.4 Detailed Recommendations

6.4.1 Alignment of Similar Items — Similar elements in circuits drawn vertically are preferably aligned horizontally (see Fig. 7).

For circuits drawn horizontally similar elements are preferably aligned vertically (see Fig. 8).

6.4.2 Connection of Functionally Related Elements — The connections between functionally related elements should be short so that the relationship is made clear (see Fig. 9).

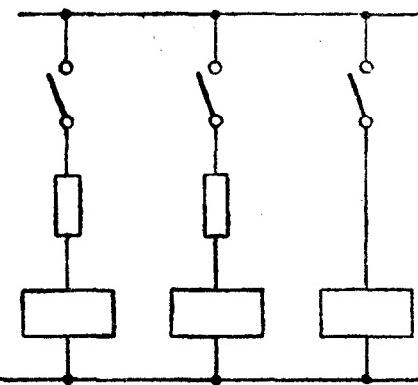


FIG. 7 HORIZONTAL ALIGNMENT OF SIMILAR ITEMS IN VERTICALLY DRAWN CIRCUITS

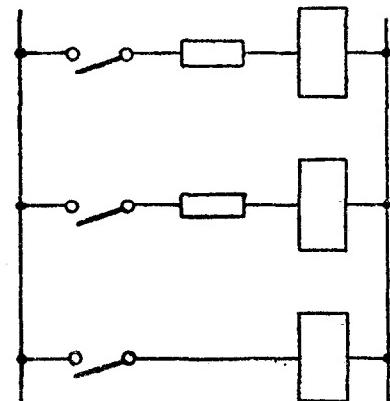


FIG. 8 VERTICAL ALIGNMENT OF SIMILAR ITEMS IN HORIZONTALLY DRAWN CIRCUITS

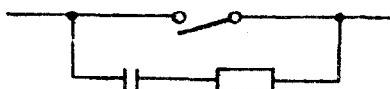


FIG. 9 CONNECTION OF FUNCTIONALLY RELATED ELEMENTS

Parallel paths of equal importance shall be symmetrically displaced with respect to the main path (see Fig. 10).

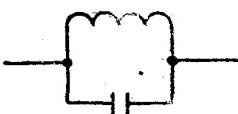


FIG. 10 PARALLEL PATHS OF EQUAL IMPORTANCE

6.4.3 Connecting Lines

6.4.3.1 Long connecting lines between parts of the circuit should be avoided.

6.4.3.2 When mechanical functions are closely related to certain electrical functions, linkage of the symbols should be shown (see Fig. 11).

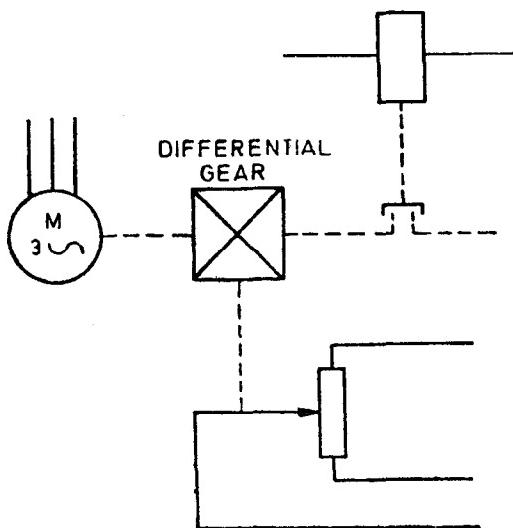


FIG. 11 LINKAGE OF SYMBOLS FOR RELATED MECHANICAL AND ELECTRICAL FUNCTIONS

6.4.4 Use of Alternative Connection Symbols — The following symbol for alternative connections may be used on the circuit diagram to show the connections which have to be made to render the equipment suitable for various alternative applications. The meaning of the numbers shall be explained by a note or table on the diagram (see Fig. 43A).

Symbol	Connection to be Made for Alternative Application
— 1 —	For application 1
— 2 —	For application 2
— 3 —	For application 3, etc

NOTE — With this technique, it may be convenient to show the symbols for some parts twice; see for example Fig. 43 where make contact 1Z 11 appears in zone B5 for alternative applications 4 and 7 and in zone B8 for application 8.

6.4.5 Crossing and Branching — IS : 2032* provides a possibility of showing a connection at a crossing point in the diagram by means of a dot [see 2.5.3 of IS : 2032 (Part II) - 1962†]. Crossing points with a dot and those without a dot may not easily be distinguished when using certain reproduction techniques. IS : 2032*, therefore, gives a method of staggering [see 2.5.3 of IS : 2032 (Part II) - 1962†] which avoids ambiguity.

Two lines representing conductors which cross on a diagram should not change direction at this

point. The change of direction should, therefore, occur at a short distance from the crossing point (see Fig. 12).

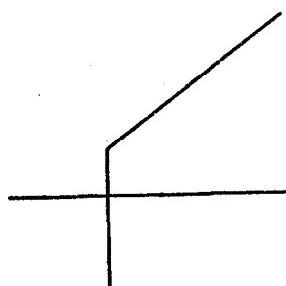


FIG. 12 CHANGE OF DIRECTION OF LINES REPRESENTING CONDUCTORS

Lines representing conductors which are joined together should preferably be drawn at right angles to one another.

6.4.6 Oblique Crossing — Oblique crossing lines may be used to connect corresponding elements in symmetrical circuits (see Fig. 13).

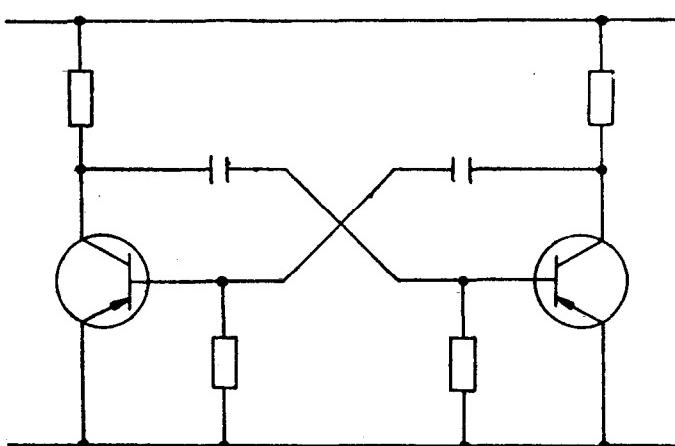


FIG. 13 OBLIQUE CROSSING

6.4.7 Boundary Lines for Functional or Constructional Units — When it is desirable in a circuit diagram to show that a part of it represents a functional or constructional unit (for example, group of apparatus, relay set, etc) this may be done by a long chain boundary line as in Fig. 14. The diagram should be laid out to give maximum clarity, even if this means that the boundary line has an irregular shape.

When such a sub-assembly is not completely represented, it should be identified by a reference number or an annotation. Figure 15 shows the use of a boundary line surrounding a sub-assembly identified by the reference number A2 and that of the diagram 609012.

As circuit diagrams should be drawn according to the general principles in 4, it may happen that a diagram within a boundary line representing a

*Graphical symbols used in electrotechnology (Parts I to XVIII).

†Graphical symbols used in electrotechnology: Part II Kind of current distribution system and method of connection.

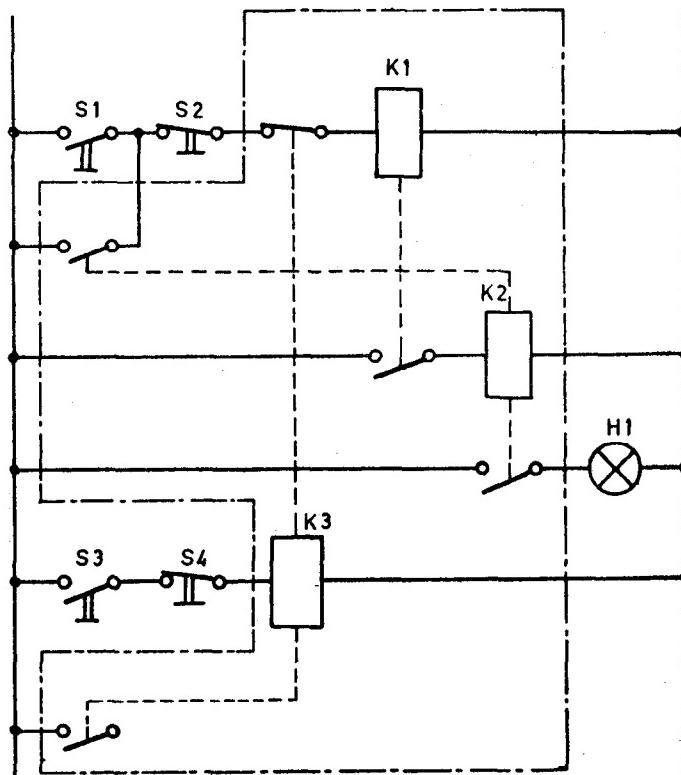


FIG. 14 LONG CHAIN BOUNDARY LINE FOR A FUNCTIONAL OR CONSTRUCTIONAL UNIT AND SEMI-ASSEMBLED REPRESENTATION WITH CROSSINGS BENDS AND BRANCHING OF LINKAGE LINES

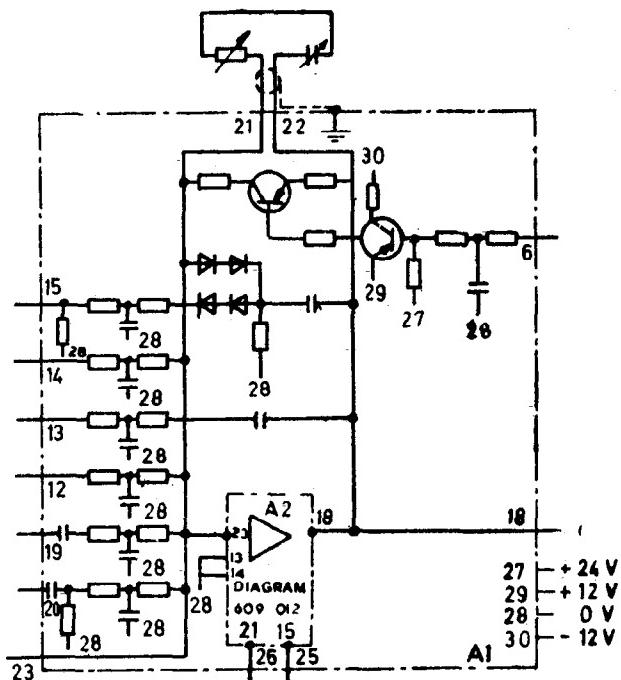


FIG. 15 IDENTIFICATION OF PARTIALLY REPRESENTED SUB-ASSEMBLY AND REPRESENTING DISTRIBUTION OF SUPPLY VOLTAGES BY TERMINAL MARKINGS (OMITTING OF LINES)

unit contains symbols for parts which do not belong to the unit. Such symbols should then be shown within a boundary line of different type and by adding a designation or a note. For example, in Fig. 16 the outer boundary line shows a unit Q6 consisting of contactor, thermal relay and fuses. Push-buttons S1 and S2 are functionally related items but are not located in unit Q6.

6.4.8 References for Interrupted Lines — When a

circuit line is interrupted on one sheet and continues on another sheet, references such as diagram number, sheet number and zone location should be shown (see Fig. 17).

If there are several references on the same sheet, they shall be distinguished, for example, by letters as in Fig. 18. The circuit function may also be used (see Fig. 43A).

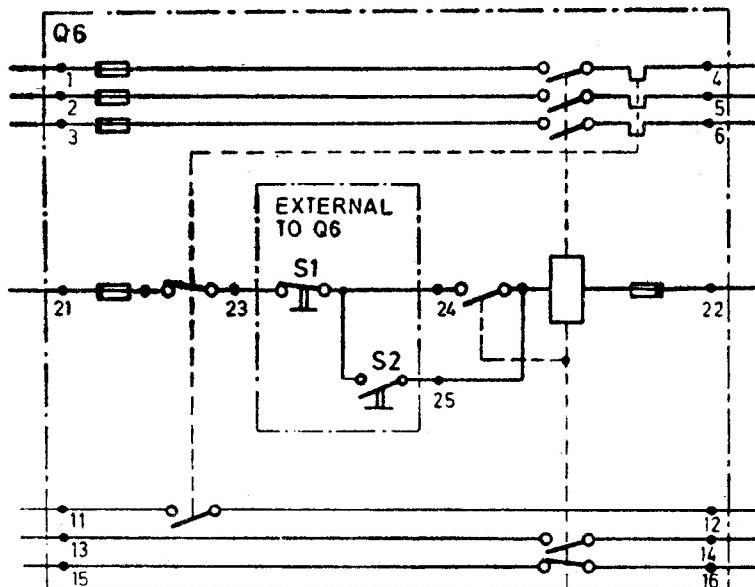


FIG. 16 FUNCTIONALLY RELATED EXTERNAL ITEMS

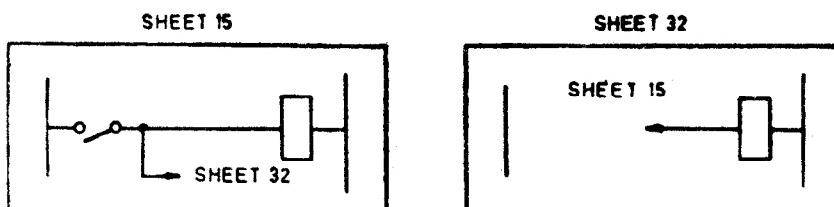


FIG. 17 REFERENCES FOR INTERRUPTED LINES

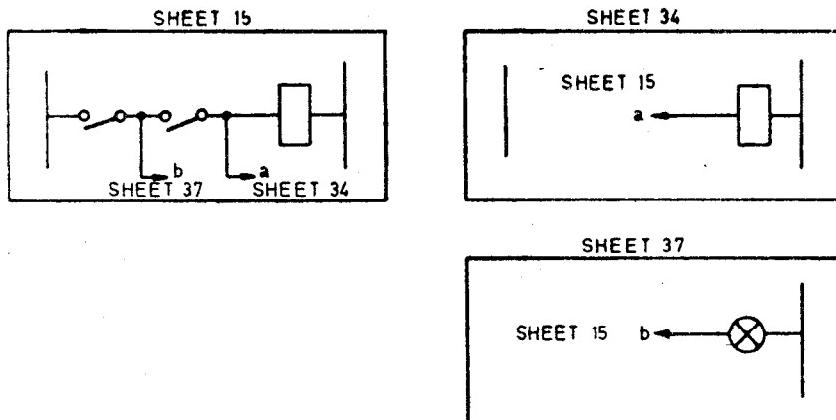


FIG. 18 SEVERAL REFERENCES FOR INTERRUPTED LINES ON THE SAME SHEET

6.5 Simplifications

6.5.1 Omitting Lines — References may be used instead of lines for common connections such as supply lines, bonding rails, etc. Figure 15 shows an example of the method where the distribution of the supply voltages ($-12V$, $0V$, $+12V$, $+24V$) within unit A1 is represented only by the terminal markings. See also Fig. 45 where the lines are designated by voltages.

6.5.2 Multiple Connection — Two or more identical branches of a current path may be represented by one figure and use of the multiple symbol, providing item designations or similar

information is associated with the symbol (see Fig. 19 to 22).

6.5.3 Simplified Representation of Constructional Units — The circuit diagram within a boundary line representing a constructional unit may, in certain cases, be simplified, if a reference to a complete diagram of the unit is inscribed.

Such simplification may be applied especially for units where inputs and outputs may be identified, as for power supply devices, amplifiers and changers. For the study of the circuit diagram, in such cases it may be sufficient to show within the boundary line a simple symbol denoting the kind

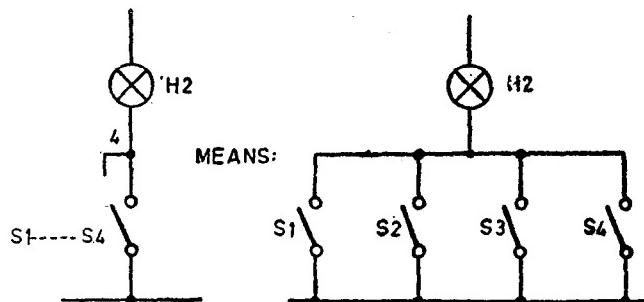


FIG. 19 EXAMPLE OF SWITCHES IN PARALLEL

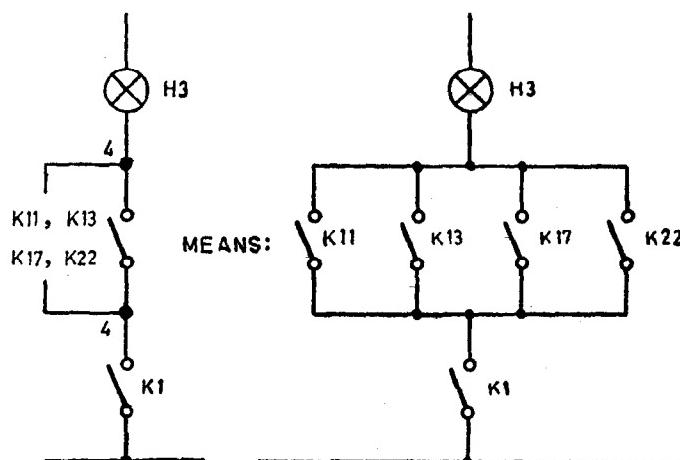


FIG. 20 EXAMPLE FOR MULTIPLE CONNECTION

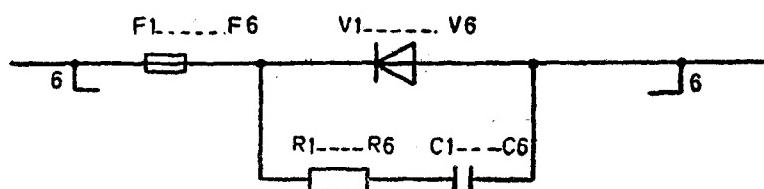


FIG. 21 EXAMPLE REPRESENTING A RECTIFIER EQUIPMENT CONSISTING OF SIX INDIVIDUALLY-FUSED DIODE CIRCUITS IN PARALLEL

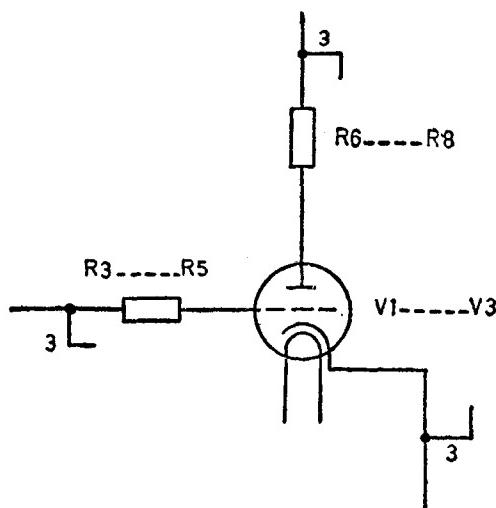


FIG. 22 EXAMPLE REPRESENTING THREE CIRCUITS CONNECTED IN PARALLEL

of device and the direction of transmission (see Fig. 15).

To identify the inputs and outputs, it may be more appropriate to indicate, within the boundary line, the most important parts of the unit. For example, see Fig. 23 where the auxiliary circuits of a circuit-breaker (closing and tripping coil, spring-operating motor and some auxiliary contacts for position indication) are identified in a rectangle. A reference to the detailed diagram is given inside the boundary line.

6.5.4 Representation of Similar Circuits — Several similar circuits may be represented by one figure showing only those designations which are valid for all circuits. The rest of the designations should then be shown in a table which may be so arranged that the designation can be found directly below the corresponding symbol. Figure 24 shows an

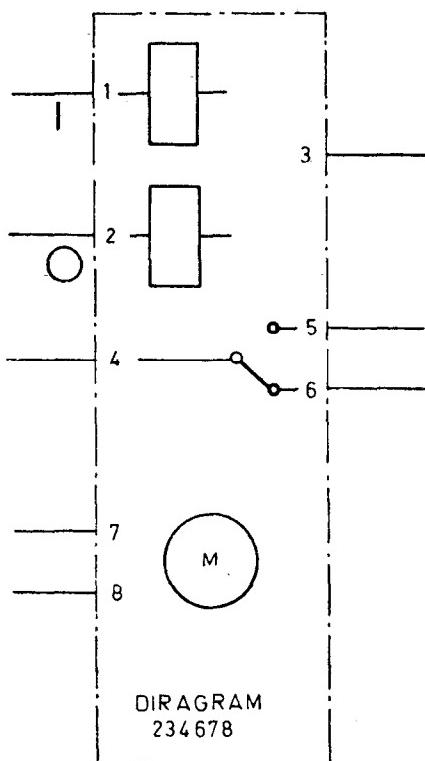


FIG. 23 SIMPLIFIED REPRESENTATION OF CONSTRUCTIONAL UNITS

example. The simplified representation is shown to the left. For explanation, the complete representation is also shown here (to the right).

6.5.5 Repeating Symbols — It is possible to clarify functional groupings and avoid a number of lines and cross-overs by repeating certain symbols. See for example Fig. 46 where the earth symbol is repeated many times.

As another example, in detached representation,

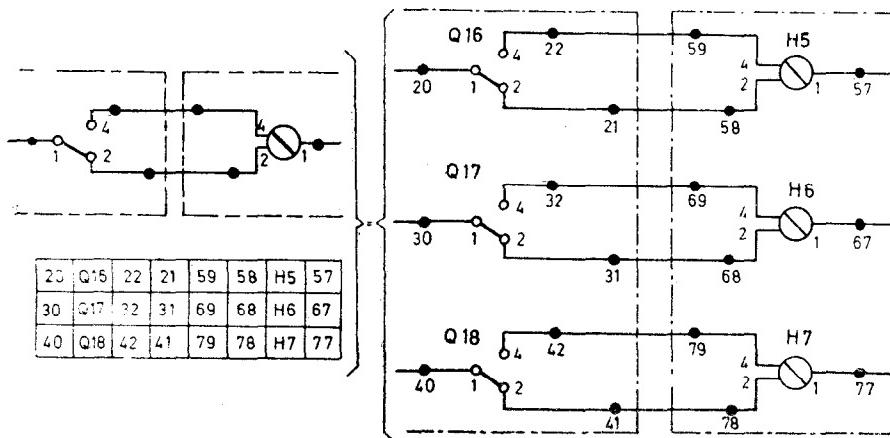


FIG. 24 REPRESENTATION OF SIMILAR CIRCUITS

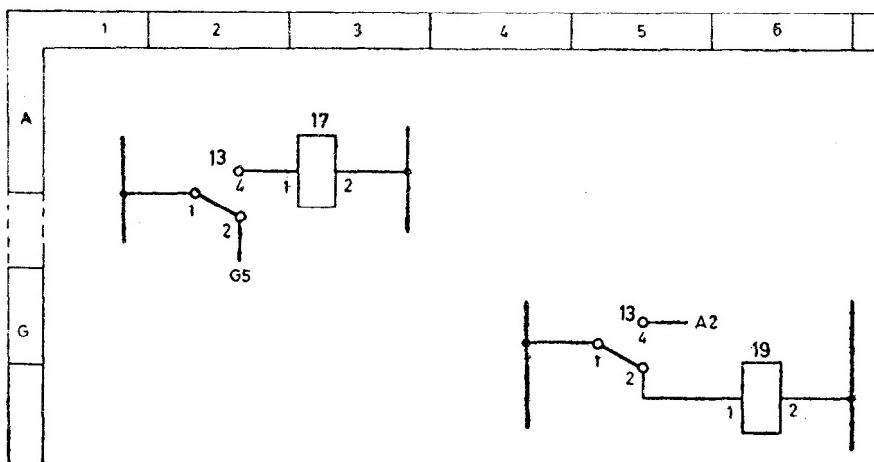


FIG. 25 ZONE LOCATION REFERENCES

a change-over contact may be shown twice, once to illustrate the make circuit and once to show the break circuit. In addition, suitable information should be given to ensure that no confusion would result. There should be some location reference showing where the other circuit is to be found. See Fig. 25 where G5 and A2 are drawing zone location references.

6.6 Recommended Layout for Fundamental Circuits — Circuit diagrams should show in a uniform manner certain fundamental circuit arrangements such as bridges, RC-coupled amplifiers, etc, which occur frequently. Recognition of these fundamental circuits is easier if each has a formalized pattern which is always used to represent the circuit. Additional components should be arranged so that the pattern is not distorted but remains recognizable.

Figures 26 to 36 are recommended layouts for a number of fundamental circuits.

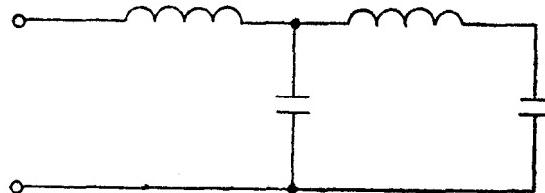


FIG. 26 TWO-TERMINAL PASSIVE NETWORK

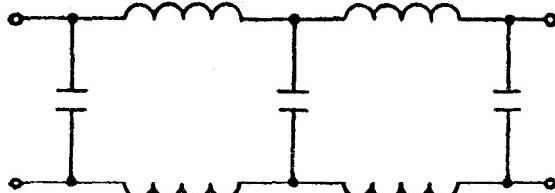


FIG. 27 FOUR-TERMINAL PASSIVE NETWORK

6.6.1 Terminations — Two-terminal passive networks should be drawn with the terminals at the same end.

Four-terminal passive networks such as filters, smoothing circuits, attenuators and phase-shift networks should be drawn with the terminals at the corners of a rectangle.

6.6.2 Basic Bridge Circuits — These circuits may be shown by three alternative methods (see Fig. 28, 29 and 30).

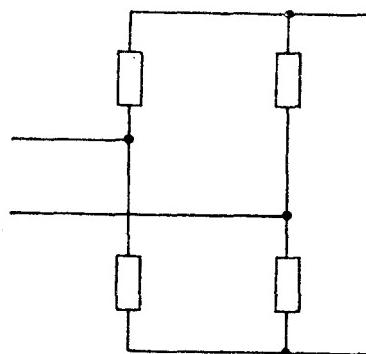


FIG. 28 BASIC BRIDGE CIRCUIT (ALTERNATIVE 1)

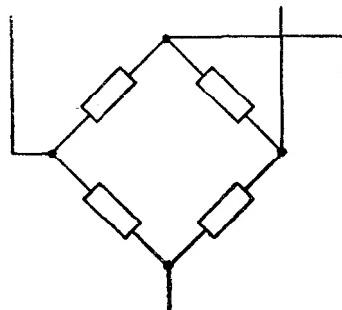


FIG. 29 BASIC BRIDGE CIRCUIT (ALTERNATIVE 2)

These methods of representation are applicable to other components or group of components.

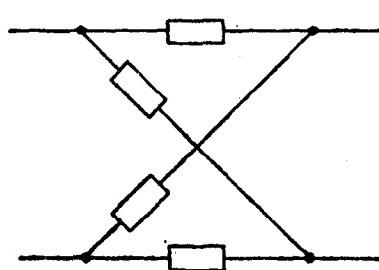


FIG. 30 BASIC BRIDGE CIRCUIT (ALTERNATIVE 3)

Figure 31 shows example of an *n*-phase converter circuit.

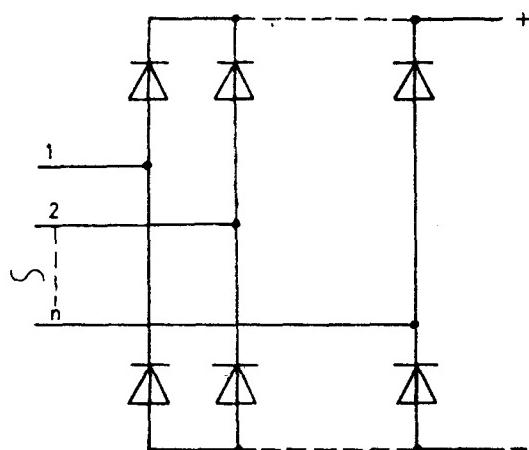


FIG. 31 N-PHASE CONVERTER CIRCUIT

6.6.3 RC-coupled Amplifying Stage — These amplifying stages are shown in the following examples with *NPM* transistor:

- a) Common base (two alternatives) (see Fig. 32 and 33).

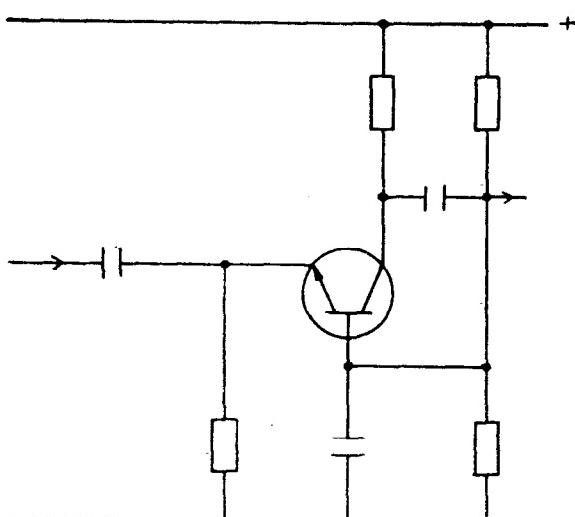


FIG. 32 COMMON BASE RC-COUPLED AMPLIFYING STAGE (ALTERNATIVE 2)

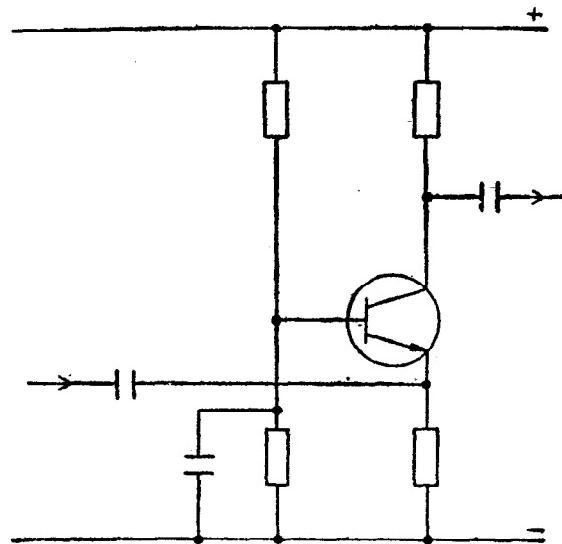


FIG. 33 COMMON BASE RC-COUPLED AMPLIFYING STAGE (ALTERNATIVE 1)

- b) Common emitter

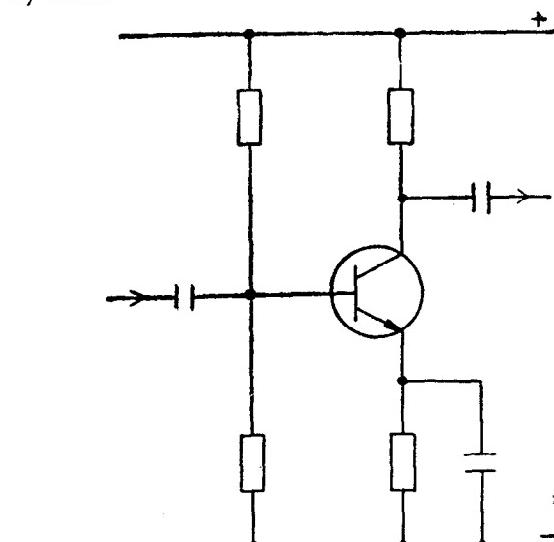


FIG. 34 COMMON Emitter RC-COUPLED AMPLIFYING STAGE

- c) Common collector (emitter follower) (see Fig. 35).

6.6.4 Motor with Star-delta Starter — This circuit is shown in Fig. 36.

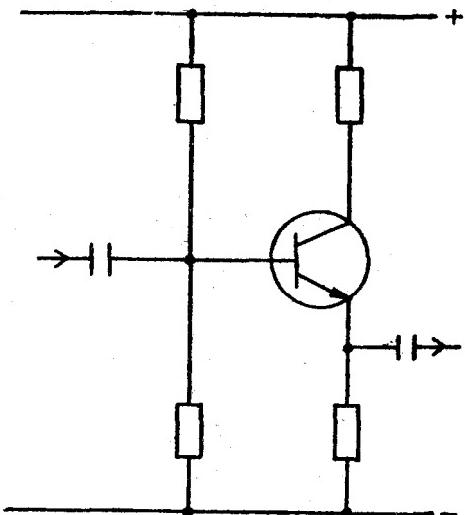


FIG. 35 COMMON COLLECTOR RC-COUPLED AMPLIFYING STAGE

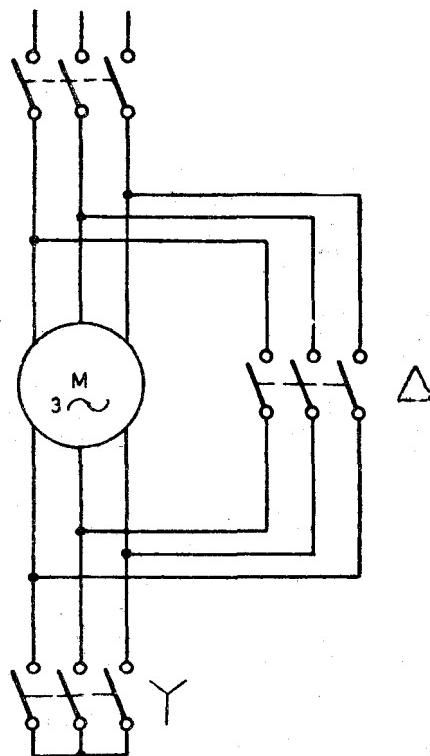


FIG. 36 MOTOR WITH STAR-DELTA STARTER

7. MARKING AND DESIGNATIONS

7.0 The circuit diagram may show item designation and terminal markings for each item. Designations may also be shown for junctions (terminals, junction blocks, plugs, sockets, etc).

For recommendations for item designation, see IS : 8270 (Part II) - 1976*. For recommenda-

*Guide for preparation of diagrams, charts and tables for electrotechnology: Part II Item designation.

tions for terminal markings, see especially IS : 4728 - 1975*; a uniform system of alphanumeric notations may be used as a uniform system of terminal markings.

Some recommendations for the location of designations in circuit diagrams are given in 7.1 and 7.2. Deviations from these recommendations may sometimes be necessary due to lack of space but the item designation, terminal marking, technical data and supplementary information should easily be distinguished.

7.1 Item Designation — In semi-assembled representation the item designation for each item shall be shown only once. This method makes it possible to align each item designation with the appropriate linkage line. The designations may be arranged in columns or rows so that it is possible to show at the top of a column or end of a row a general part of the item designation, for example, location according to IS : 8270 (Part II) - 1976† (see Fig. 37).

In detached representation, the item designation shall be shown at each element symbol. For examples, see Fig. 39 and 43A.

7.2 Designation of Terminals and Junctions

7.2.1 For terminals of relays, resistors, etc, generally no terminal symbols (O or •) are shown. The designations of terminals are shown at convenient places adjacent to the component symbol.

7.2.2 Each junction of a connecting device (terminal board, connector, etc) intended for connection on site, or for testing and fault location is represented by a symbol and given a designation. However, the terminal symbol may be omitted when the junction is shown by the intersection of a connection with a boundary line representing a constructional unit (see Fig. 15); the designation is then marked alongside the boundary line.

8. EXPLANATORY NOTES

8.1 Brief explanatory notes or tables should be used where the meaning may not conveniently be conveyed by other means. If informative markings for controls, connectors, etc, appear on an equipment panel, these same markings, preferably framed in an outline for emphasis should appear adjacent to the graphical symbol for the item in the diagram.

9. INSCRIPTION OF TECHNICAL DATA

9.1 Numerical data and explanatory wording such as component information may be placed adjacent to the symbols if desired. It is also permissible to give data, for example, resistance values, inside rectangular symbols such as those for relay coils. In both cases, suitable space should be left for qualifying symbols.

*Terminal markings and direction of rotation for rotating electrical machinery (first revision).

†Guide for preparation of diagrams, charts and tables for electrotechnology: Part II Item designation.

For some examples, see IS : 2032 (Part II) - 1962* and IS : 2032 (Part IV) - 1964†.

Data as mentioned above may also be given in a separate table.

10. EXAMPLES OF COMPLETE CIRCUIT DIAGRAMS

10.1 Figures 37 to 48A are intended to show the application of the recommendations given in 4 to 9. They are intended only to show the different methods of representation and are not meant as recommendations concerning the equipment.

The examples depict equipment of different kinds. It is, however, not the intention to prescribe that the method of representation, chosen here for a certain kind of equipment, is specific for equipment of this kind.

Item designations which are not in accordance with Tables 1 and 2 of IS : 8270 (Part II) - 1976‡ are used in some examples as permitted by 5.2.1 of that standard. In such cases, the designations used are explained or referenced on the diagram as described in the standard.

Figures 37 to 39 show three variants of a circuit diagram for the same equipment, a milling machine.

This equipment consists of several sub-assemblies:

- A1 sub-assembly for power supply
- A2, A3, A4 sub-assembly for motors M1, M2, M3 respectively
- A5 sub-assembly for auxiliary circuit supply
- C control station
- M equipment on the machine

Those terminal symbols which are not directly attached to component symbols represent terminals of these sub-assemblies.

In Fig. 37 all the circuits are shown on one figure, and they are drawn vertically. The figure is an example of semi-assembled representation with straight mechanical linkage symbols. The table to the right shows the item designation for contactors, relays, etc, as well as those of the sub-assemblies, where these elements are located.

In Fig. 38 the main circuits are shown in Fig. 38A, the auxiliary circuits in Fig. 38B, and all are drawn horizontally. The figure uses a combination of detached and semi-assembled representation. The relationship of the elements belonging to one item is shown partly by the linkage symbol, partly by references. Example: 2/D stands for Fig. 38B, row D.

In Fig. 39 all the circuits are shown on one figure, and they are drawn vertically. Detached

representation is used with column references. However, some mechanical linkage symbols, which facilitates understanding and are easy to insert, have been shown. The inset diagrams for contactors and relays are shown at the bottom of the diagram.

In Fig. 40 a circuit reference system is used. Control circuit numbers are shown at the bottom of the diagram. Circuits for normal power supply are designated 1 . . . 4, circuits for emergency power supply 5 . . . 7. Circuits for main power 11 . . . 13 and 21 . . . 23 as referenced in the table are not shown here, as they are of no interest for the explanation of the system.

Figure 41 shows the circuit diagram of an equipment for starting a motor in the two directions with automatic breaking by counter-current.

This figure is an example of detached representation of a simple item of equipment in which the relationship between the elements of each unit may easily be seen from the item designation alone. It also includes an example of the application of 5.6 to show the functioning of centrifugal switch S2. The symbol for the contacts of drum controller S1 are arranged in line and a graph of the drum are drawn opposite them. Therefore, it is unnecessary to supply an inset diagram to aid the clarity of the circuit diagram.

Figure 42 represents part of the control equipment for a transformer station 50/10 kV.

Due to the size and complexity of the equipment the complete circuit diagram consists of a number of pages, only 4 of which are shown here. Figure 42A depicts the main circuits of a transformer with protective relays and measuring devices, Fig. 42B the auxiliary power supply, Fig. 42C and 42D the control equipment for the 50 and 10 kV circuit-breakers.

Semi-assembled representation is generally used. For each relay all the symbols for its contacts are drawn adjacent to the coil symbol in the circuit diagram.

Figure 43A represents a group selector of a telephone system. Detached representation is used with row and column references. Figure 43B and 43C show two different layouts of subsidiary 'pictorial tables' for the components, that is, relays 1A, 1C, 1J, etc. For each contact and winding symbol the co-ordinates (row and column) are given in the tables.

This figure represents a piece of equipment which may be used in different ways by changing the connections. The table at the bottom of the diagram indicates the connections which should be made for different usages of the equipment. All these connections are shown in the diagram. For example, connection . . . 2 . . . may be found in square A7.

Figure 44 also represents a piece of a telephone equipment is also drawn in detached representation. The inset diagrams for relays K1, K2, etc, are shown on the right and the zonal system is used for the referencing.

*Graphical symbols used in electrotechnology: Part II Kind of current distribution system and method of connection.

†Graphical symbols used in electrotechnology: Part IV Rotating machines and transformers.

‡Guide for preparation of diagrams, charts and tables for electrotechnology: Part II Item designation.

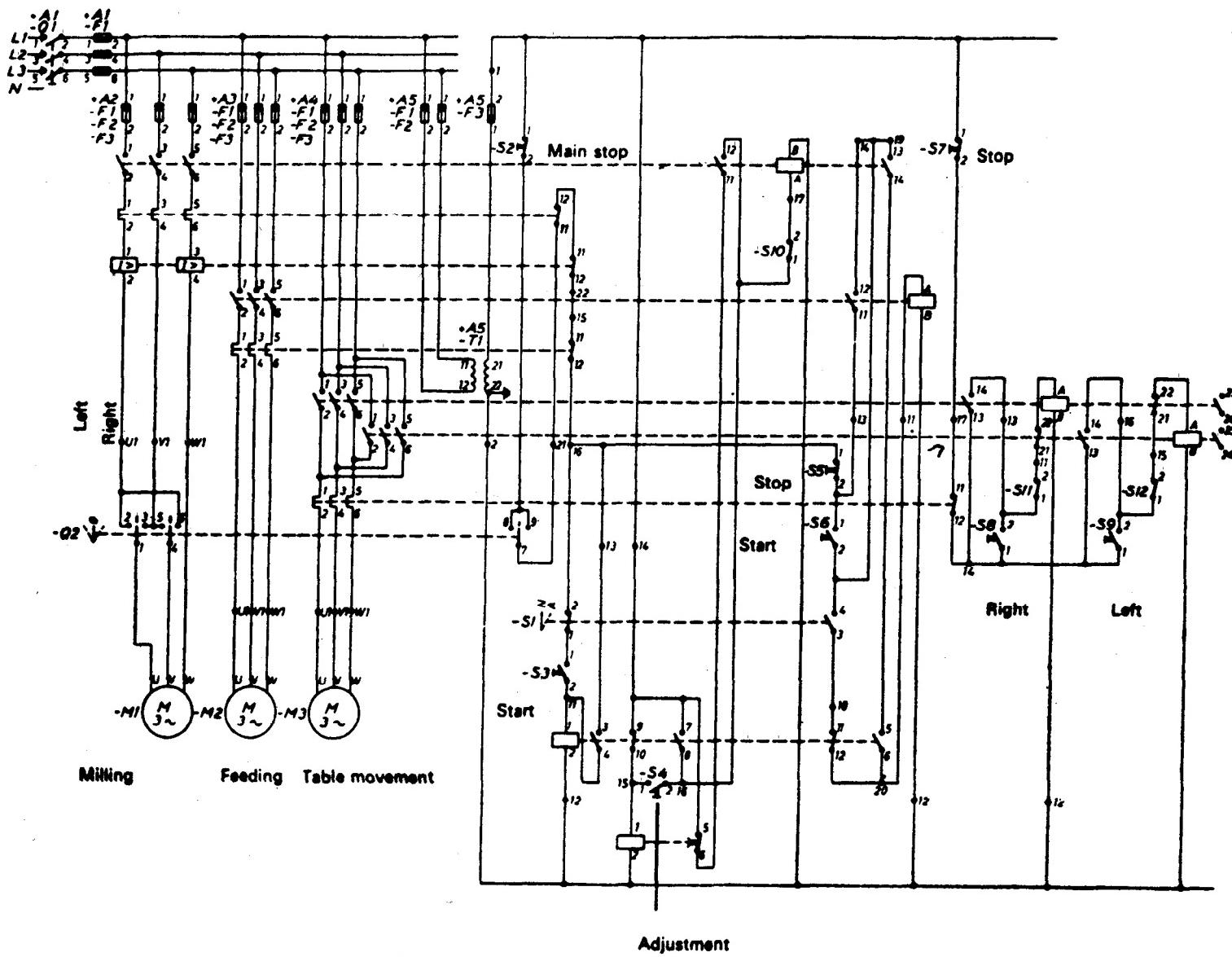
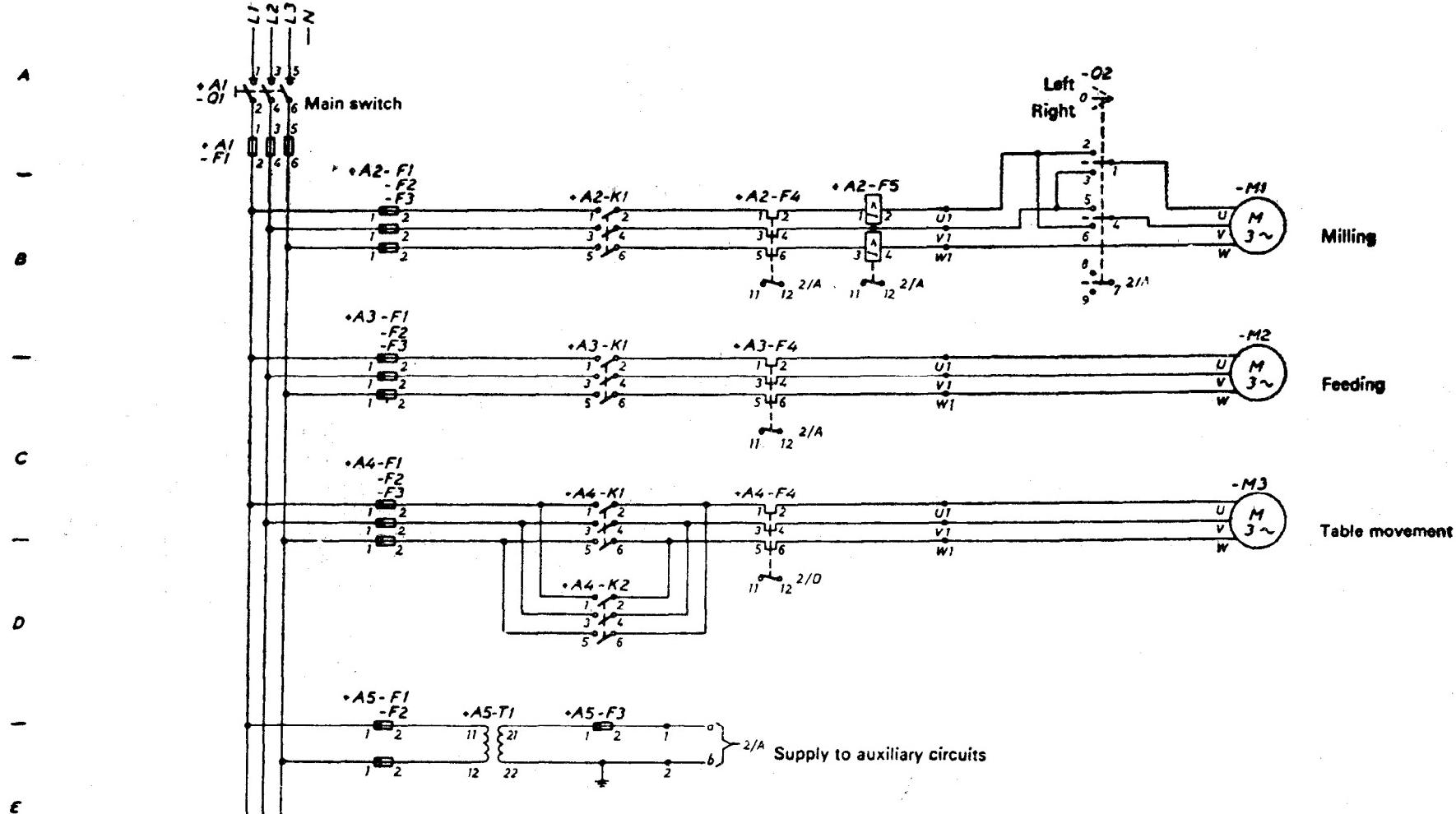


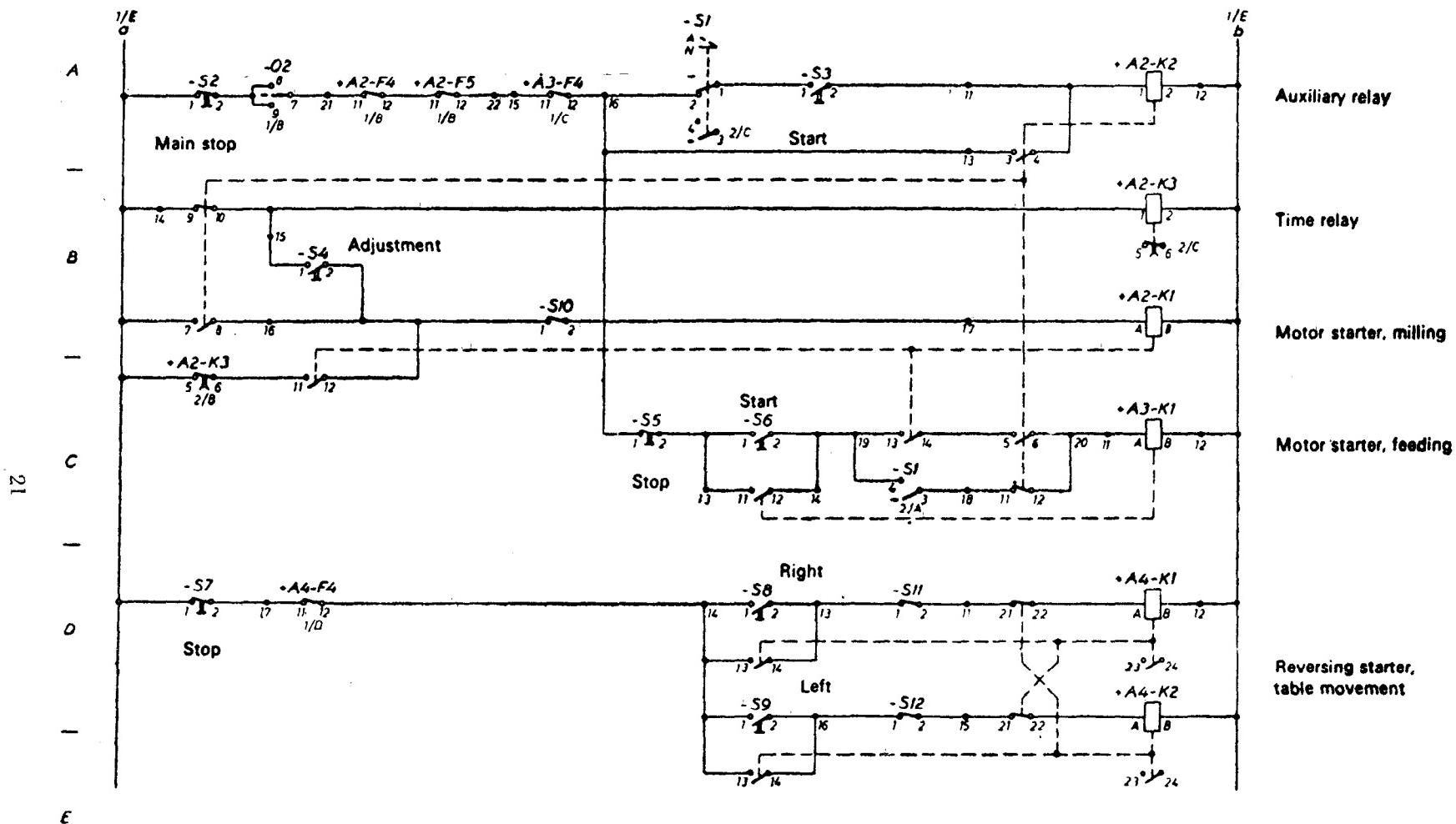
FIG. 37 SEMI-ASSEMBLED REPRESENTATION WITH STRAIGHT MECHANICAL LINKAGE SYMBOLS AND REPRESENTATION OF UNUSED ELEMENTS

Item designation						
A_1	A_2	A_3	A_4	A_5	C	M
O_1						
F_1						
	$F_{..}$	$F_{..}$	$F_{..}$	$F_{..}$		
						S_7
					K_1	
					F_4	
					F_5	
					K_1	
					F_4	
					T_1	
					K_1	
					K_2	
					S_5	
					S_6	
					S_8	
					S_9	
					S_{10}	
					S_1	
					S_3	
					M_1	
					K_2	
					S_4	
					K_3	



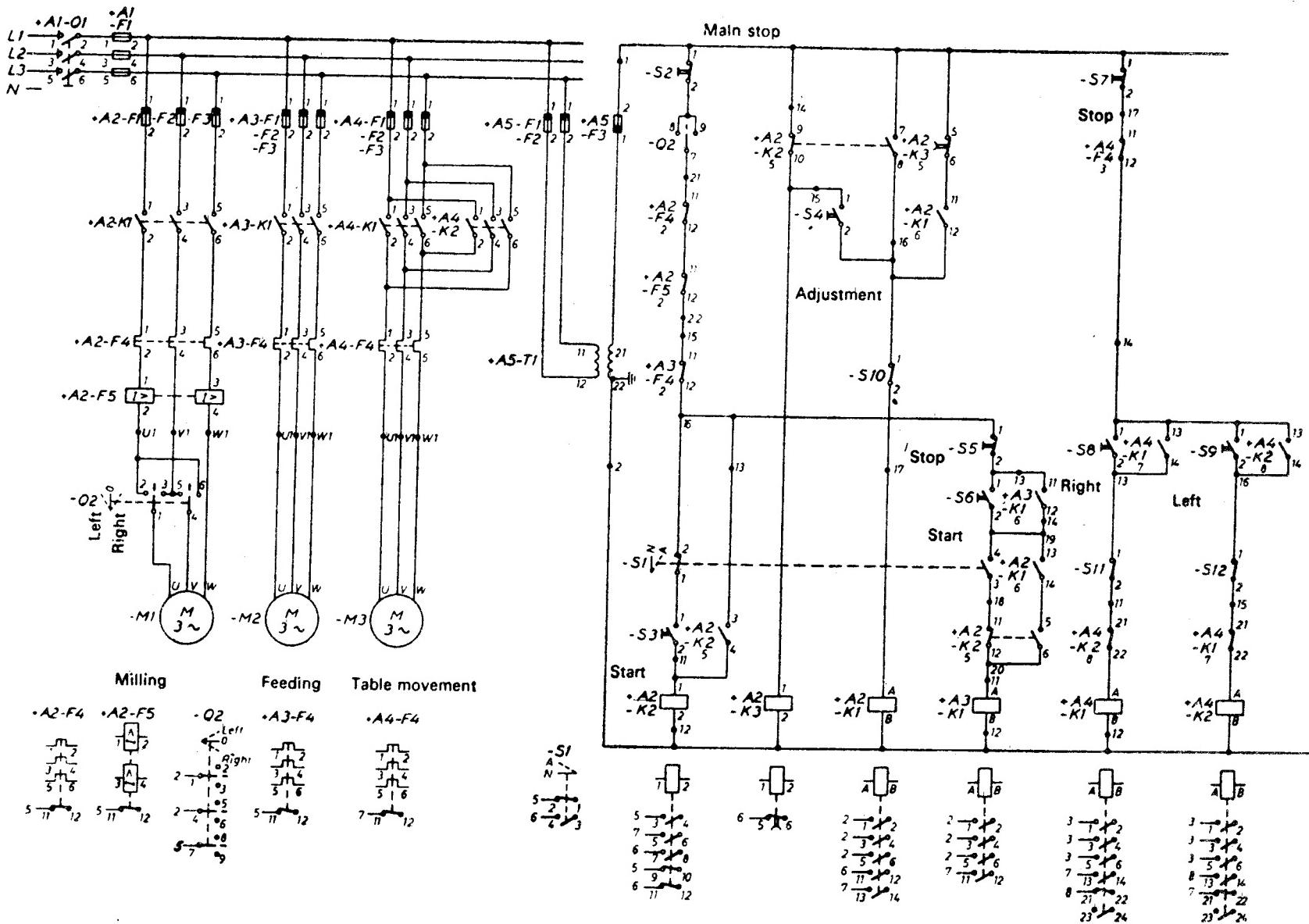
38A Main Circuits

FIG. 38 ZONAL REFERENCE SYSTEM USING REFERENCES WITH SHEET NUMBERS AND ROW DESIGNATIONS AND A COMBINATION SEMI-ASSEMBLED REPRESENTATION WITH CROSSINGS, BENDS AND BRANCHING OF LINKAGE LINES — *Contd*



38B Auxiliary Circuits

FIG. 38 ZONAL REFERENCE SYSTEM USING REFERENCES WITH SHEET NUMBERS AND ROW DESIGNATIONS AND A COMBINATION SEMI-ASSEMBLED REPRESENTATION WITH CROSSINGS, BENDS AND BRANCHING OF LINKAGE LINES



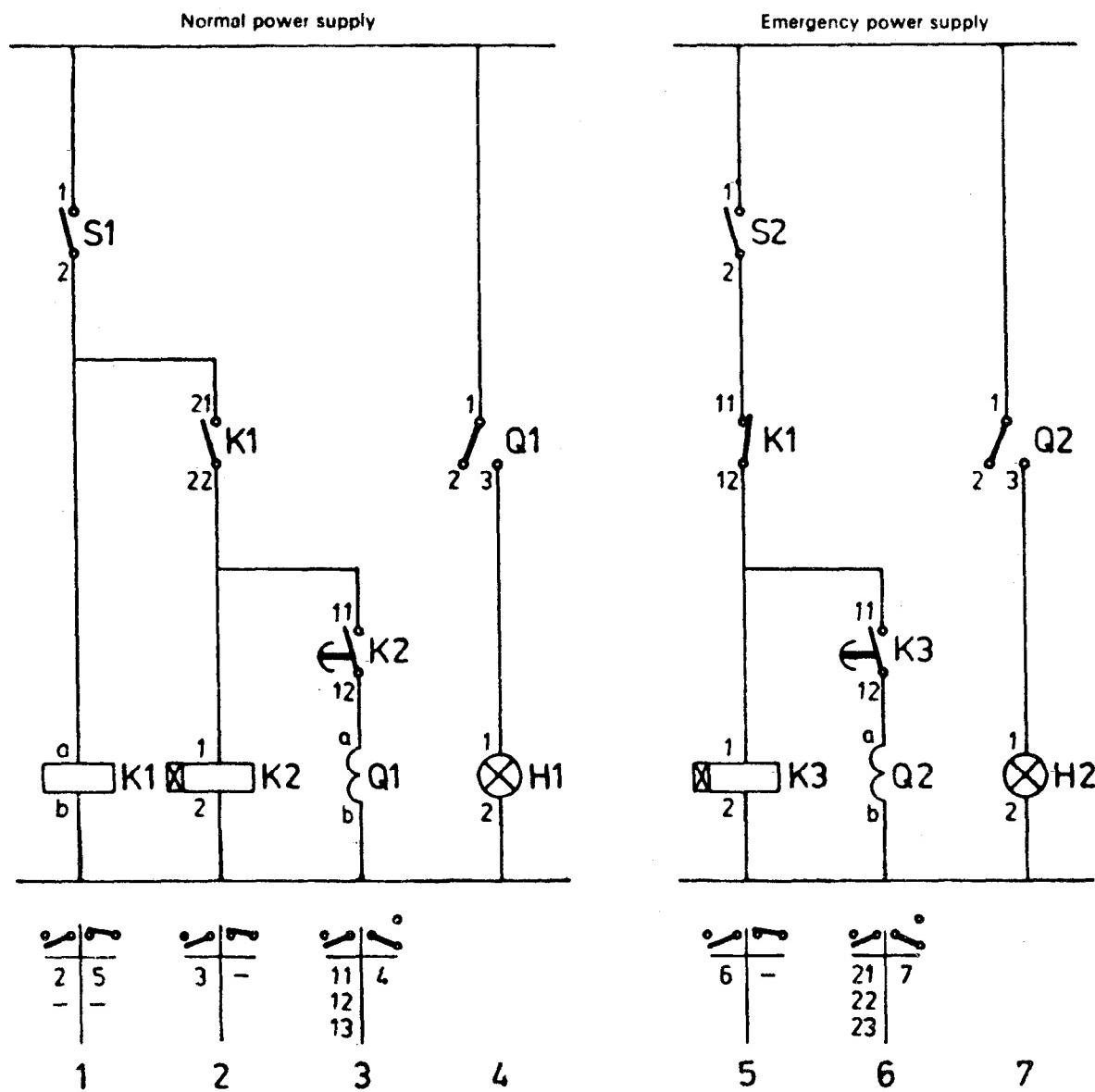


FIG. 40 CIRCUIT REFERENCE SYSTEM

Figure 45 represents a video amplifier and its power supply using transistors. In this example technical data for components such as resistors, capacitors and fuses is included.

Figure 46 is a circuit diagram showing part of the I.F. stages and detector of a page printing receiver. For filters F1, F2 and F3 only simple block symbols are used, but references to insert diagrams, not shown here are included. The diagram illustrates the simplification possible with

identical circuits (see 6.5.4). In this case, however, since only two circuits are concerned, the component references for the second circuit are merely given in brackets.

Figure 47 is an example using the tabular system for symbol location (see 5.1.2).

Figure 48A represents an AM broadcast receiver. The functional unit A1 is represented in a simplified form within boundary lines. Figure 48B is the detailed diagram of this unit A1.

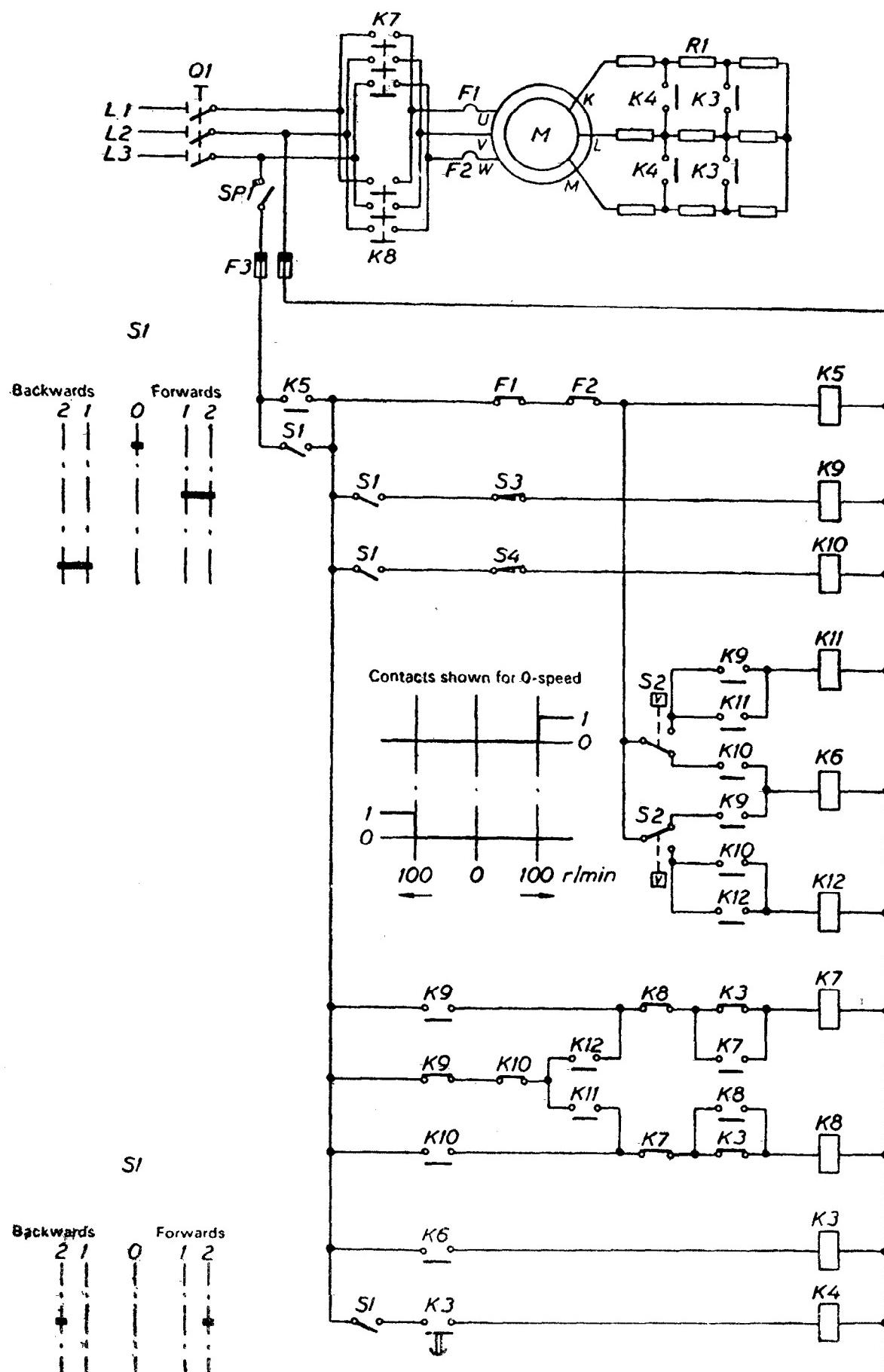


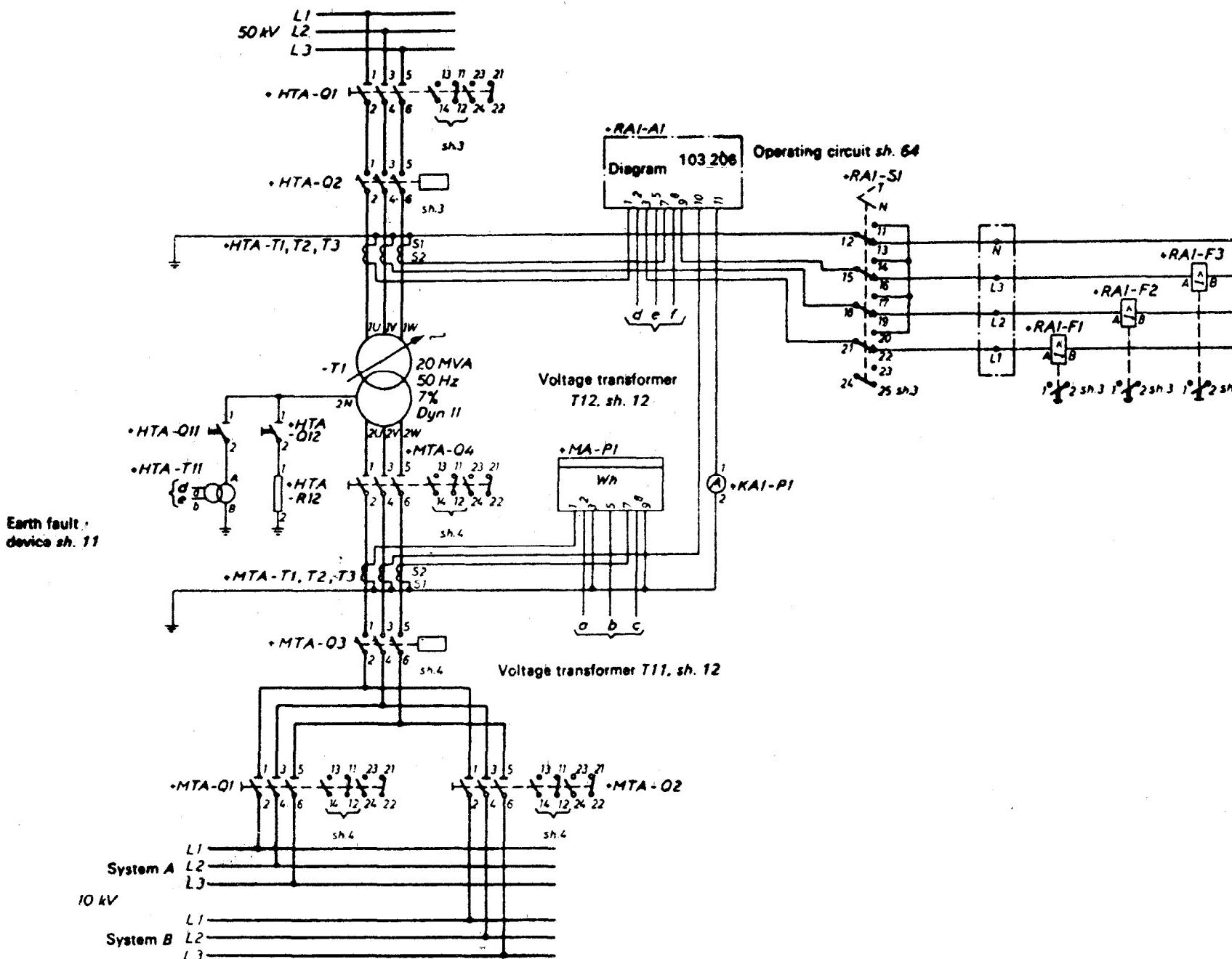
FIG. 41 AN EQUIPMENT FOR STARTING A MOTOR

Transformer T1

Voltage regulator

Over-current protection

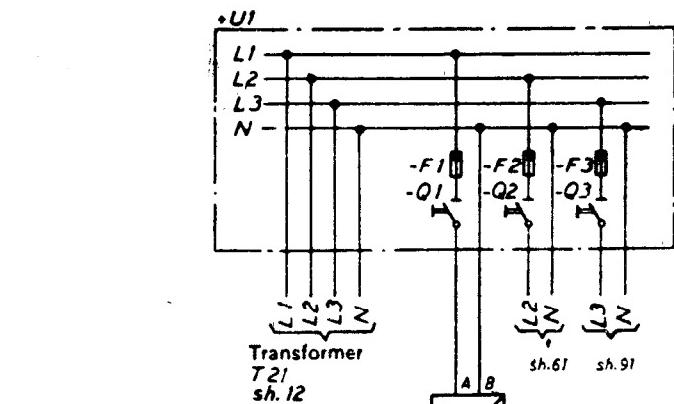
Power consumption



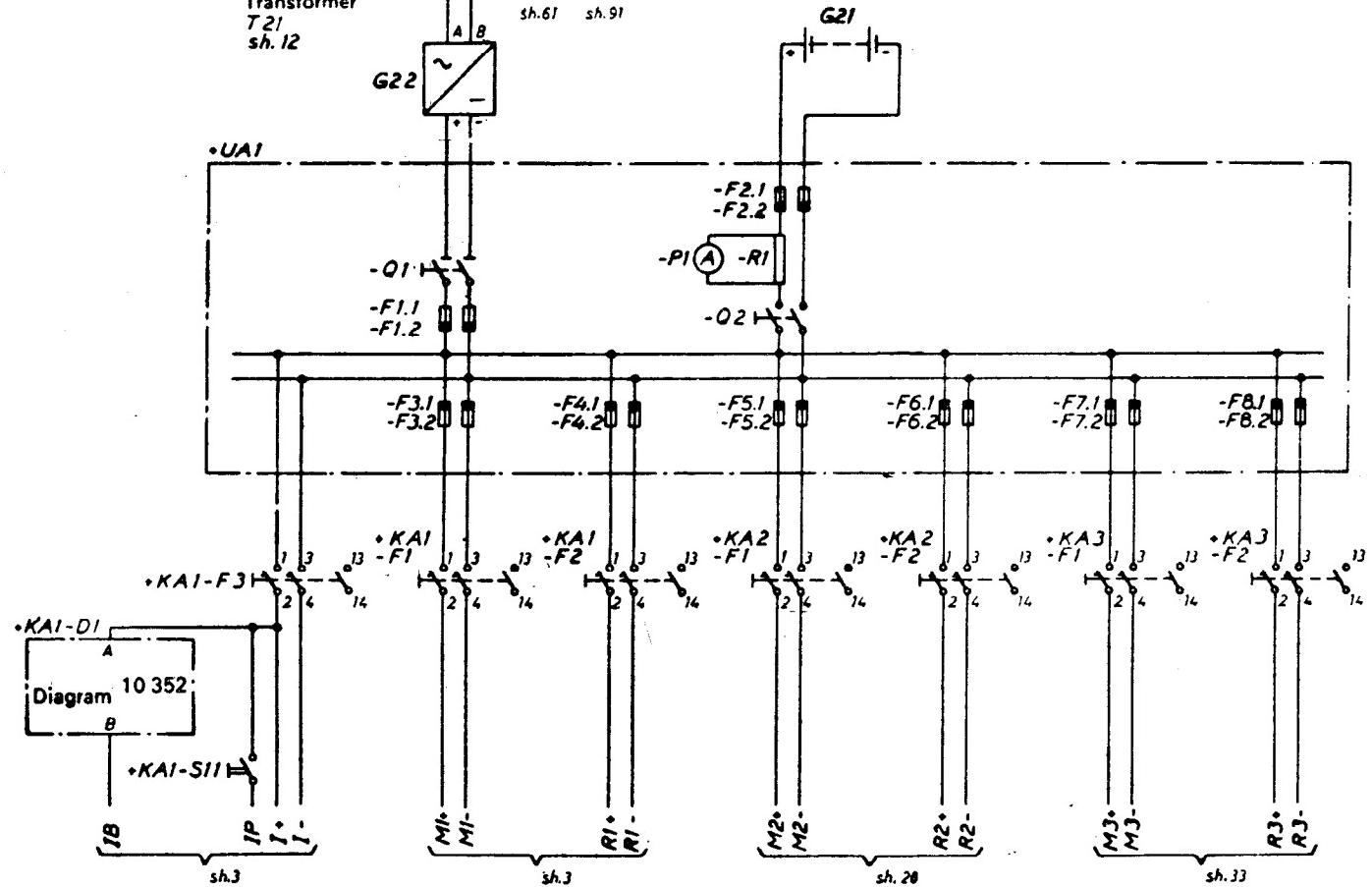
42A Main Circuits of a Transformer with Protective Relays and Measuring Devices

FIG. 42 PART OF CONTROL EQUIPMENT FOR A TRANSFORMER STATION 50/10 kV — Contd

A.C. distribution board



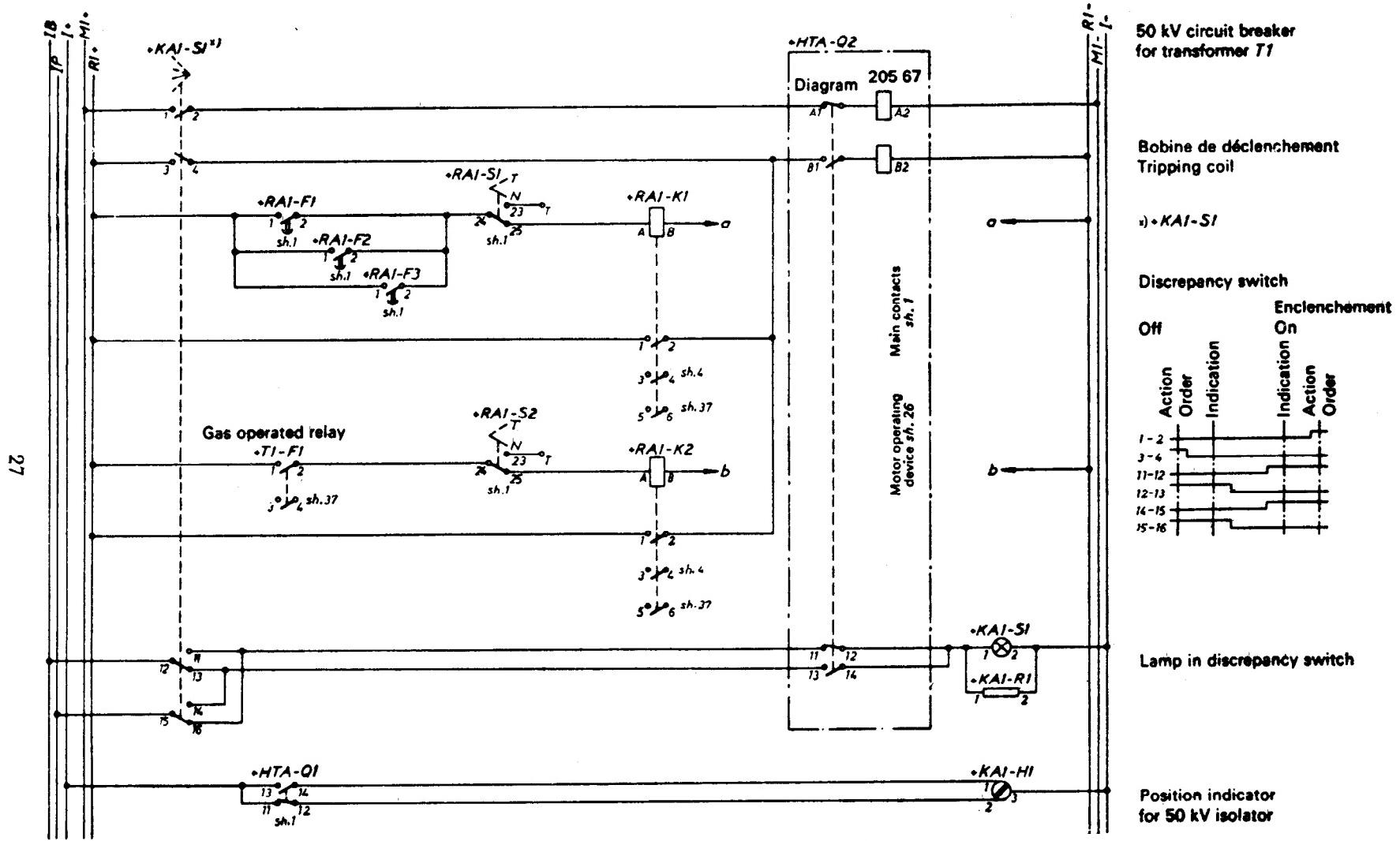
D.C. distribution board



Miniature circuit breakers

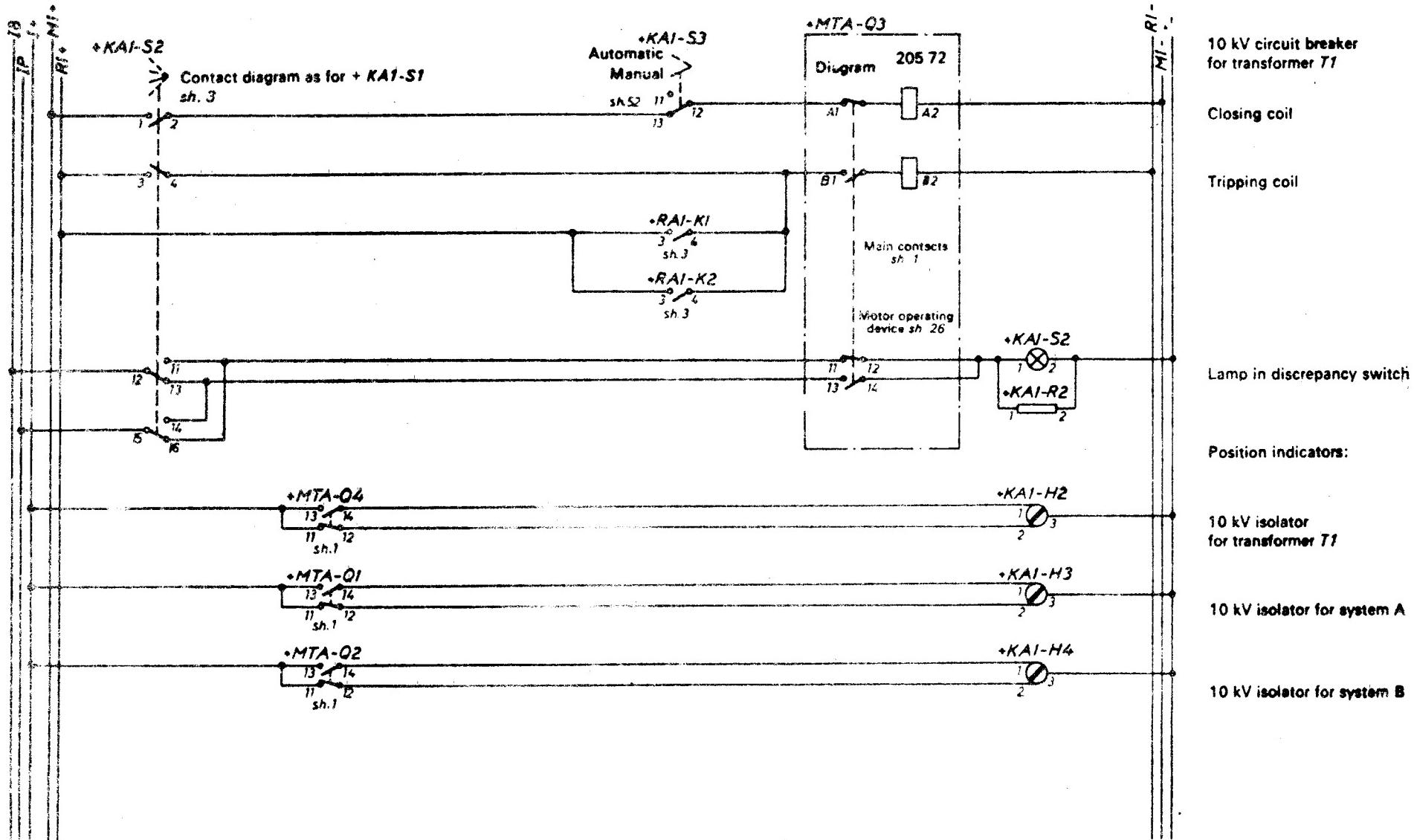
42B Auxiliary Power Supply

FIG. 42 PART OF CONTROL EQUIPMENT FOR A TRANSFORMER STATION 50/10 kV — Contd

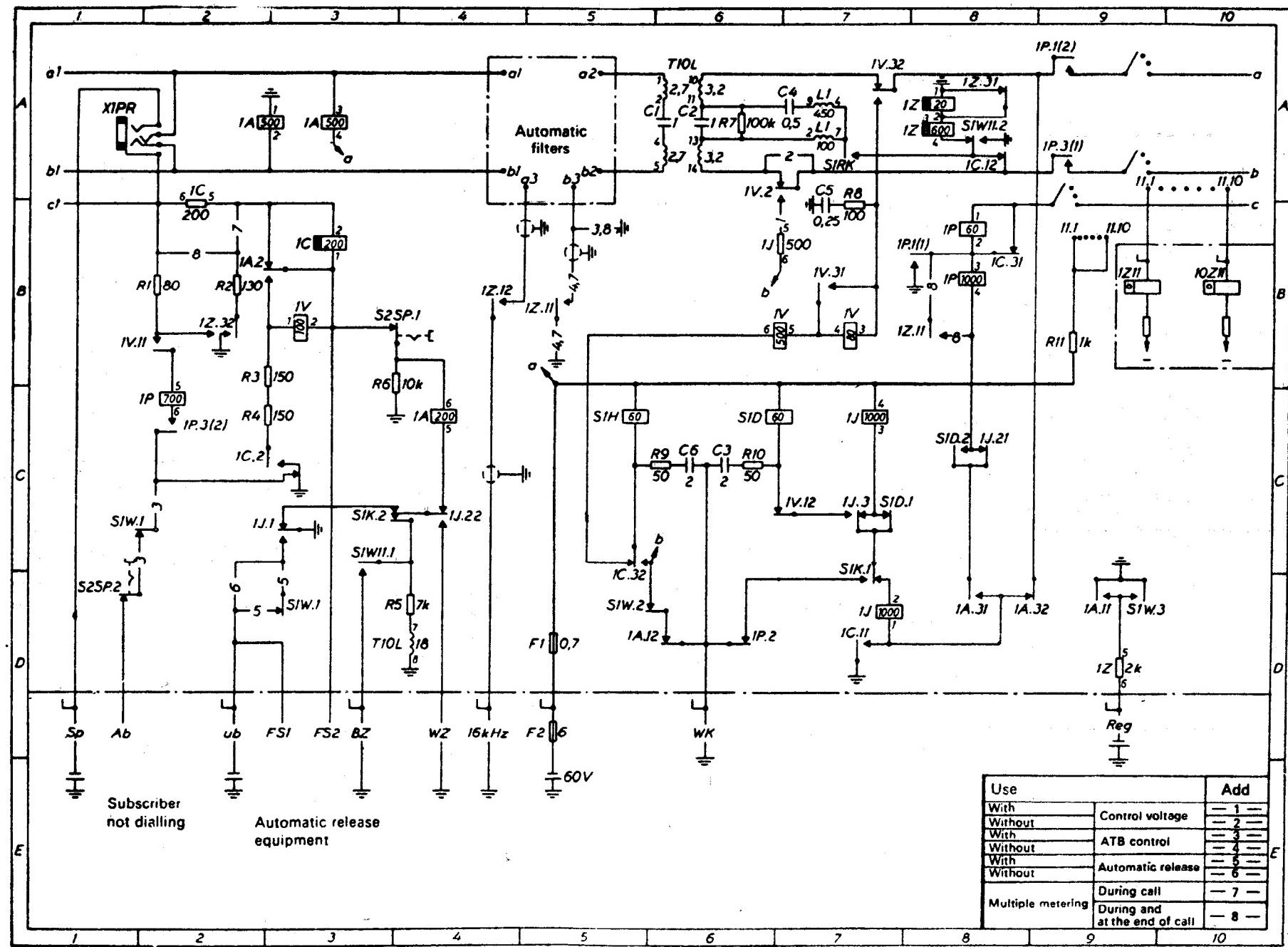


42C Control Equipment for 50 kV Circuit Breaker

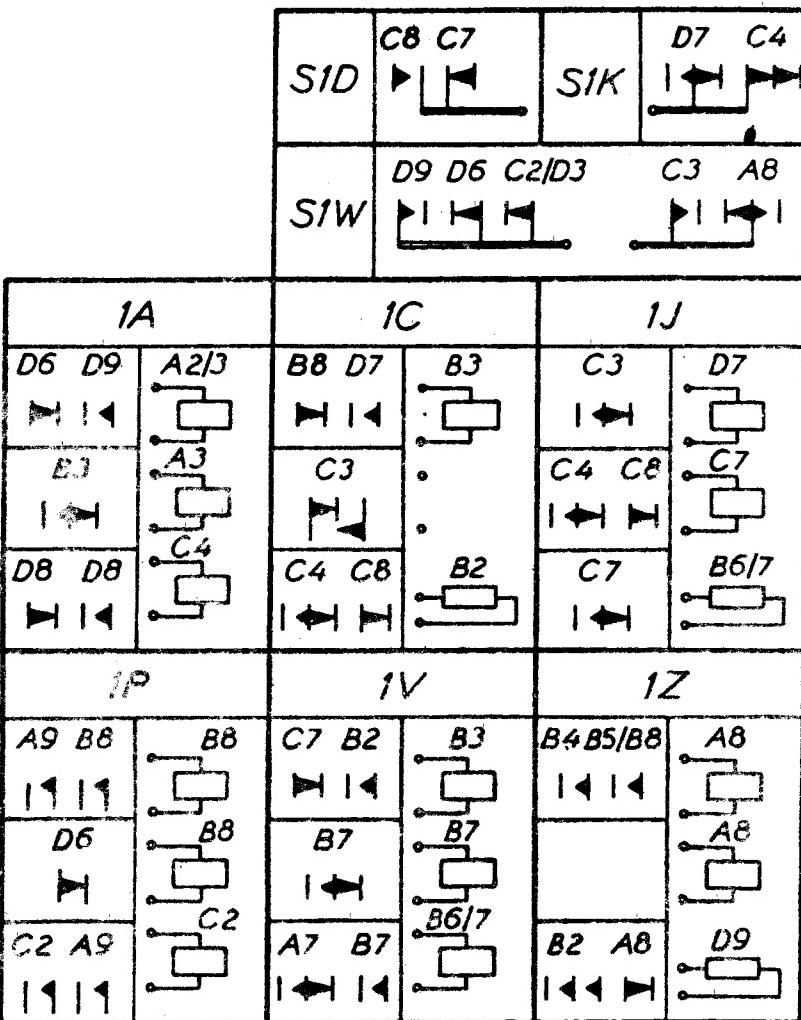
FIG. 42 PART OF CONTROL EQUIPMENT FOR A TRANSFORMER STATION 50/10 kV — Contd



42D Control Equipment for 10 kV Circuit Breaker
FIG. 42 PART OF CONTROL EQUIPMENT FOR A TRANSFORMER STATION 50/10 kV

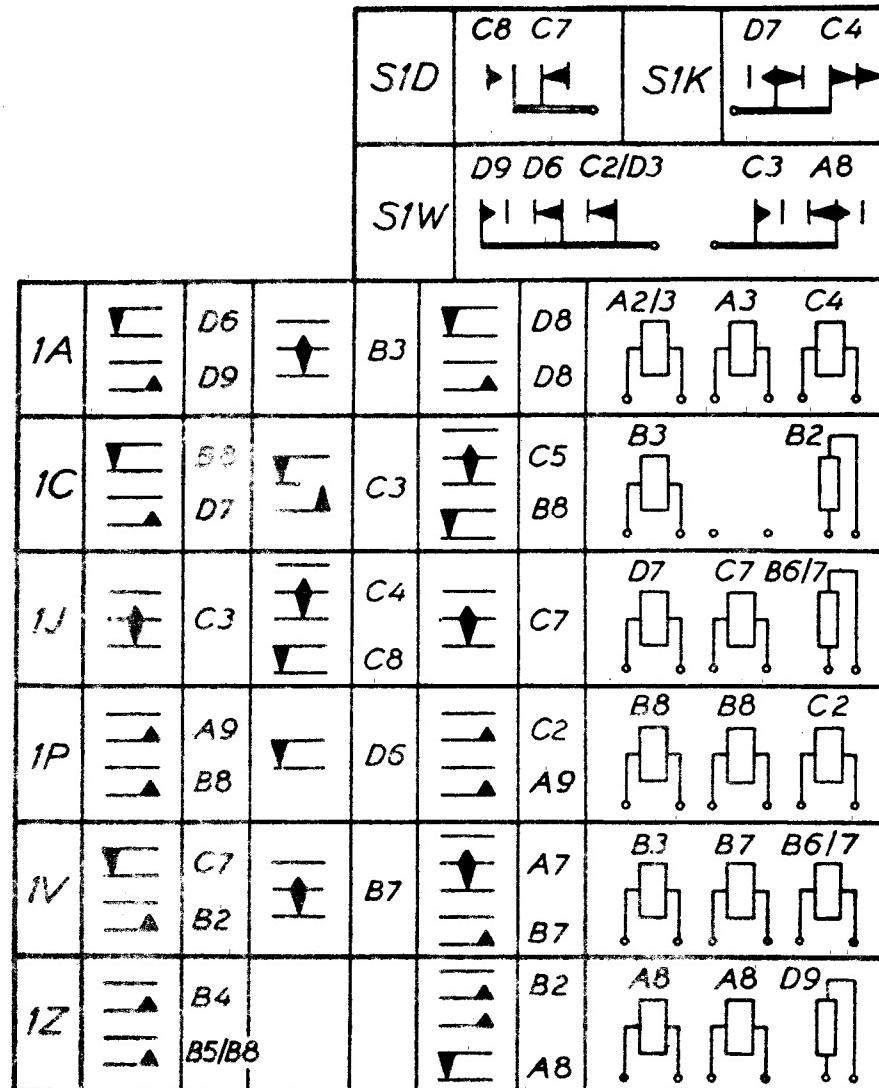


43A Group Selector of a Telephone System
**FIG. 43 ZONAL REFERENCE SYSTEM USING REFERENCES WITH RECTANGULAR ZONE DESIGNATIONS,
 DISTINGUISHING REFERENCES BY CIRCUIT FUNCTIONS, AND INSET DIAGRAMS — Contd**



43B Subsidiary Pictorial Table for the Components

FIG. 43 ZONAL REFERENCE SYSTEM USING REFERENCES WITH RECTANGULAR ZONE DESIGNATIONS,
DISTINGUISHING REFERENCES BY CIRCUIT FUNCTIONS, AND INSET DIAGRAMS



43C Alternate Subsidiary Pictorial Table for the Components

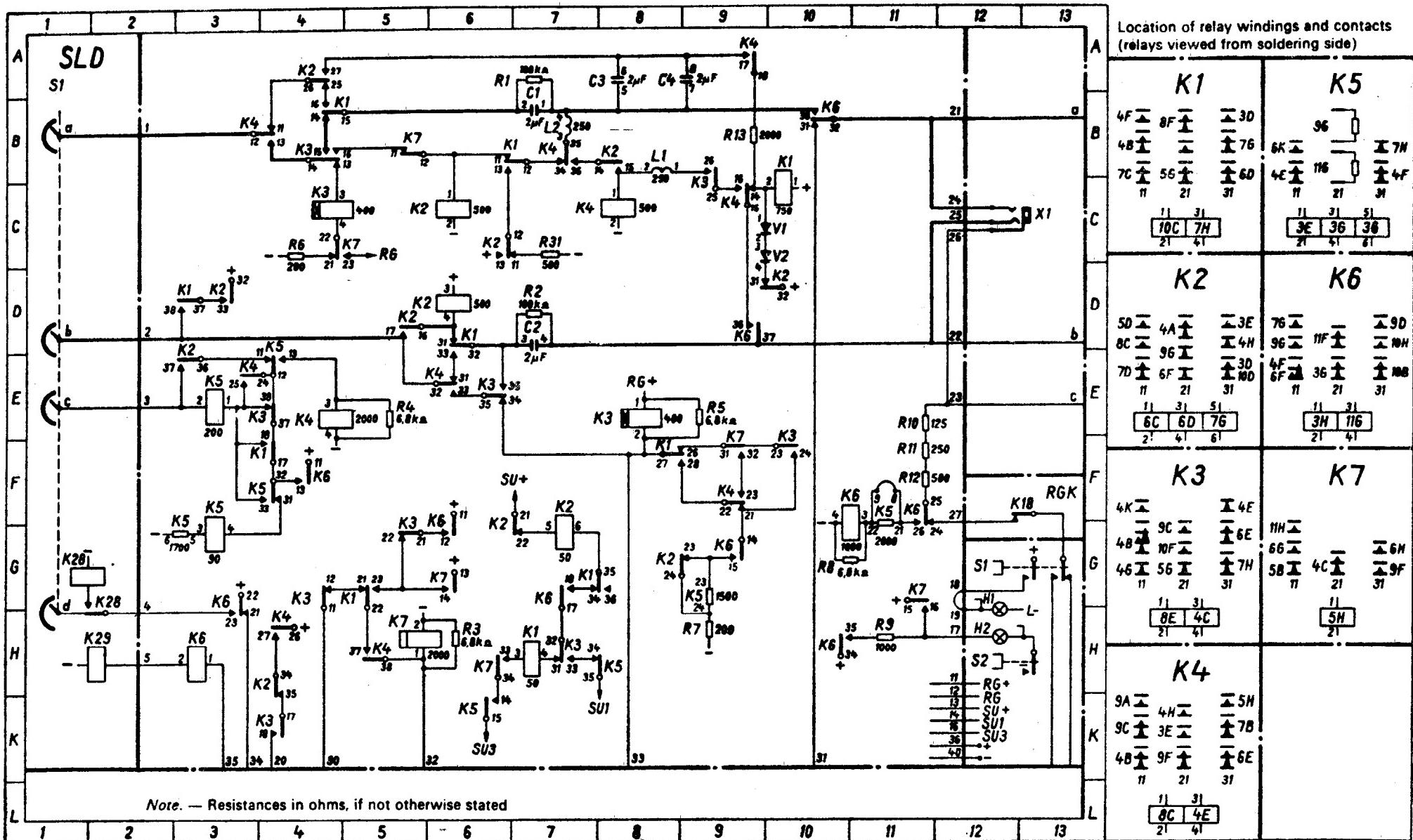


FIG. 44 ZONAL REFERENCE SYSTEM USING REFERENCES WITH RECTANGULAR ZONE DESIGNATIONS AND SHOWING TOPOGRAPHICAL REPRESENTATION OF INSET DIAGRAMS FOR REFERENCING OF PARTS IN DETACHED REPRESENTATION

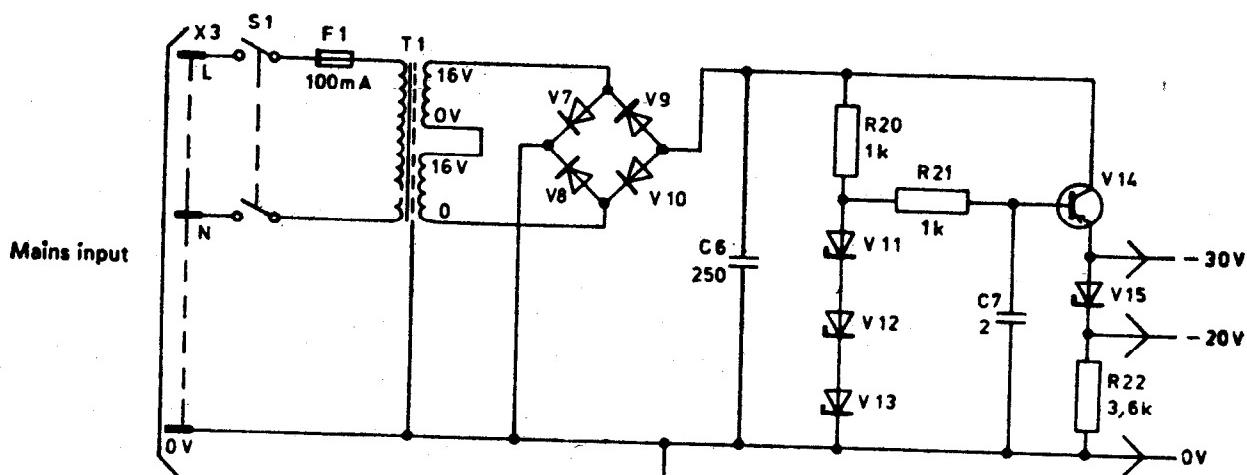
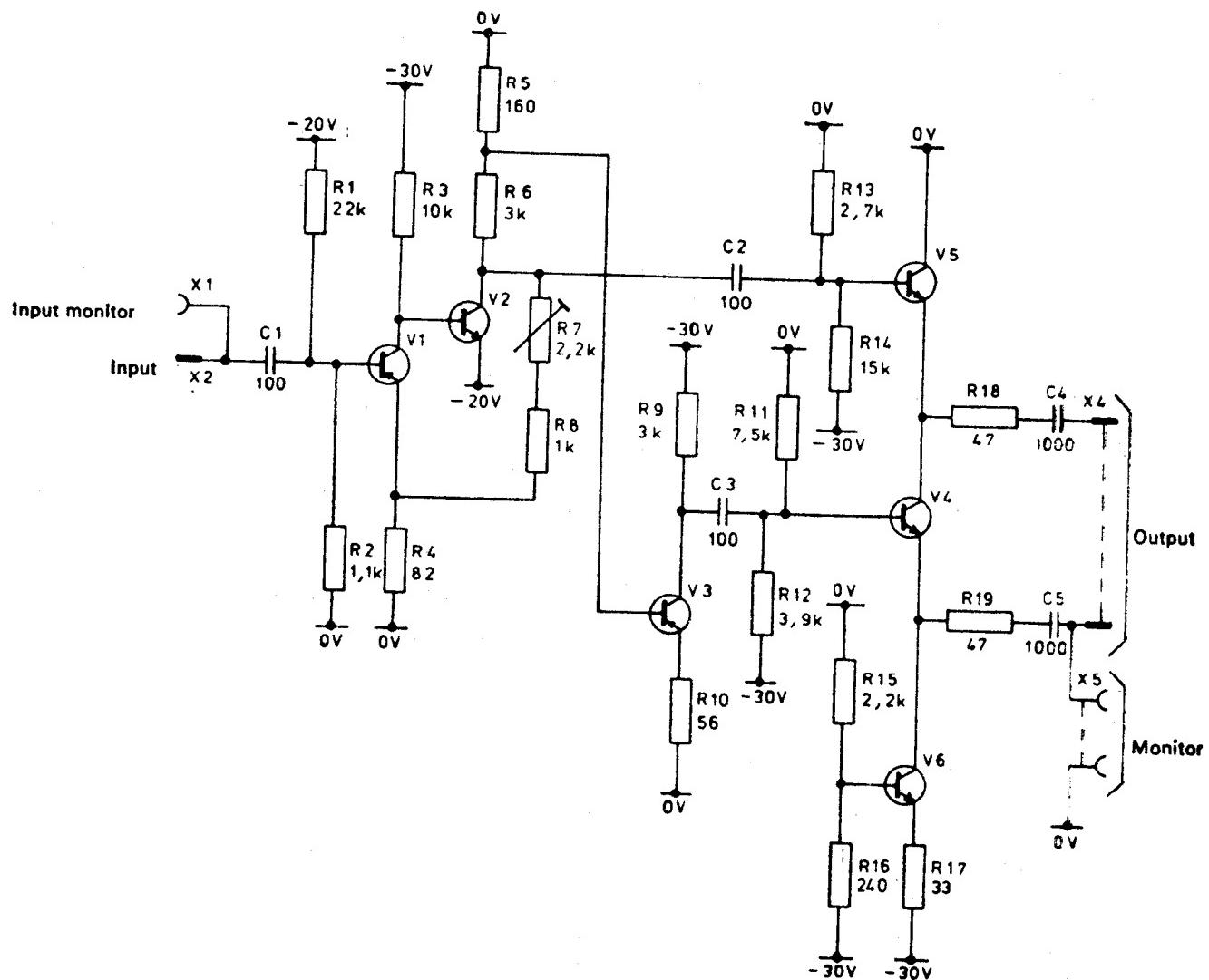


FIG. 45 LINES DESIGNATED BY VOLTAGES (OMITTING OF LINES)

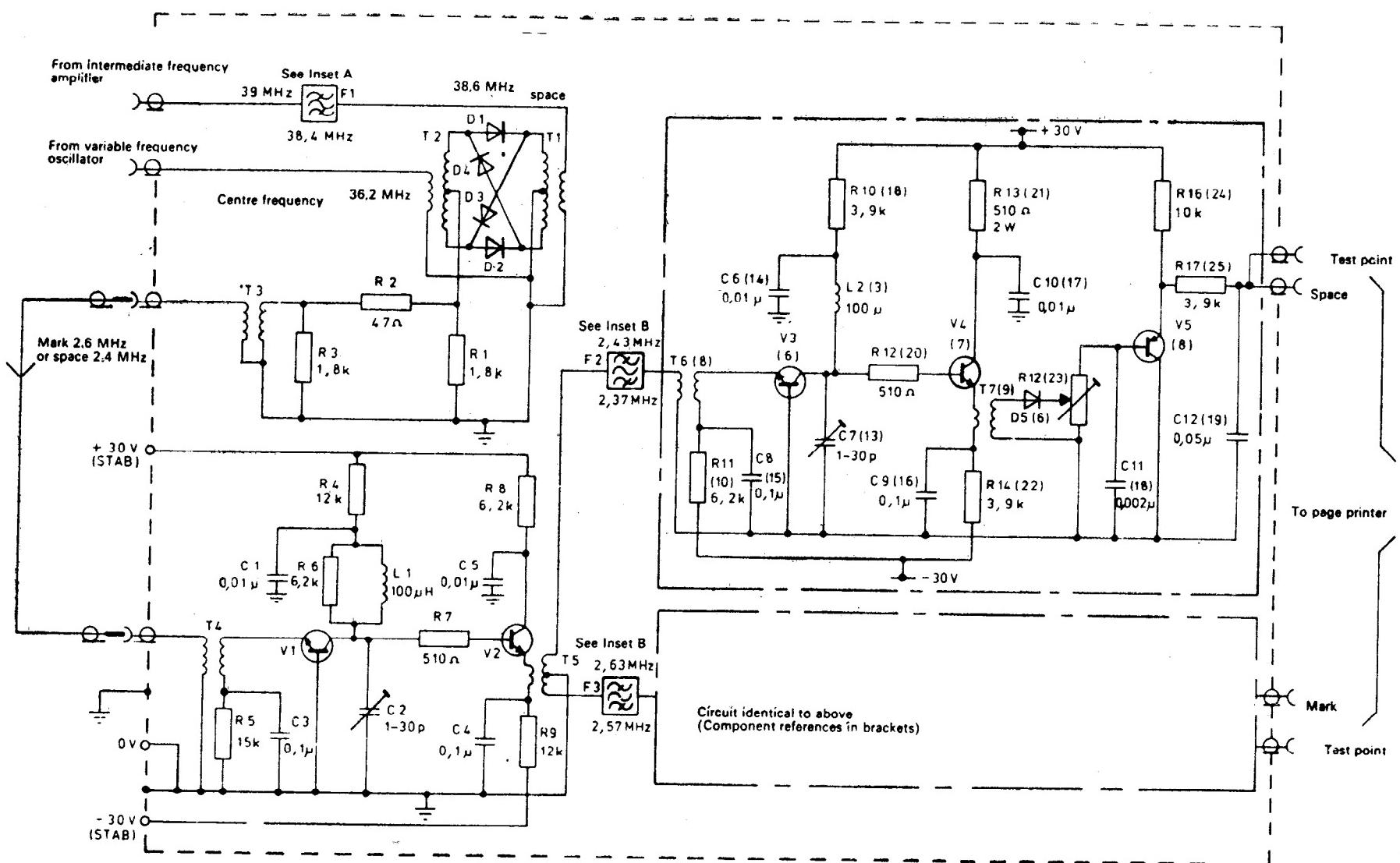
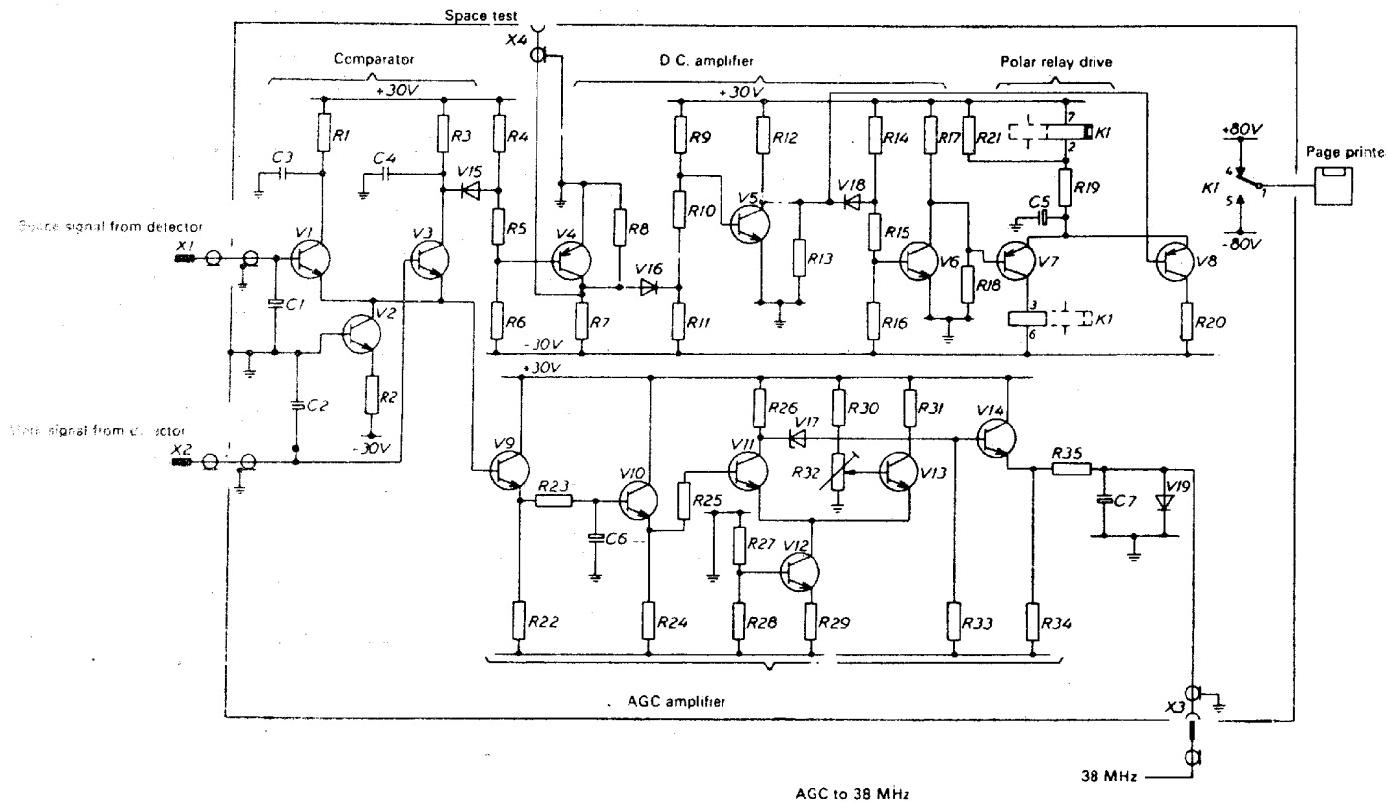
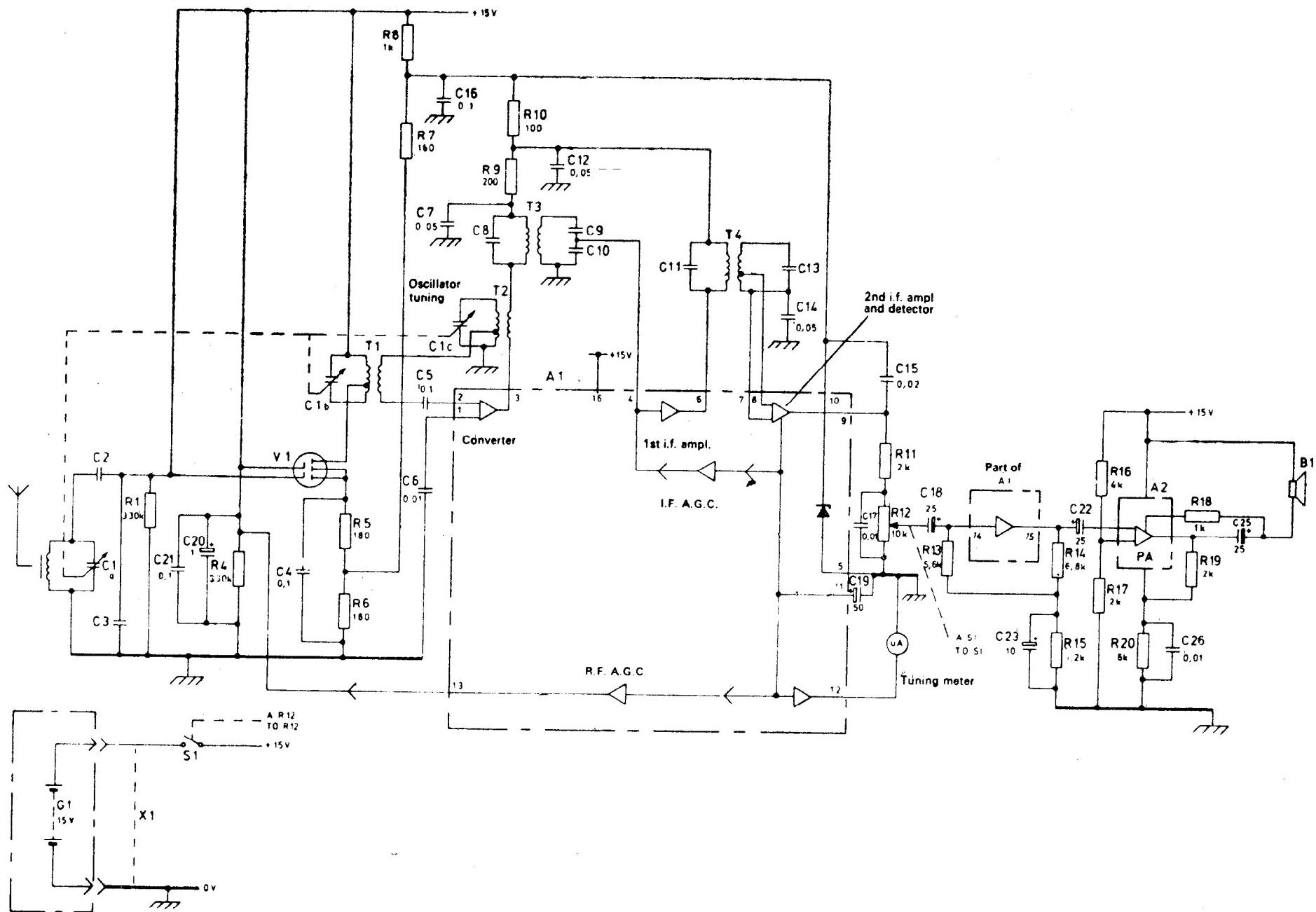


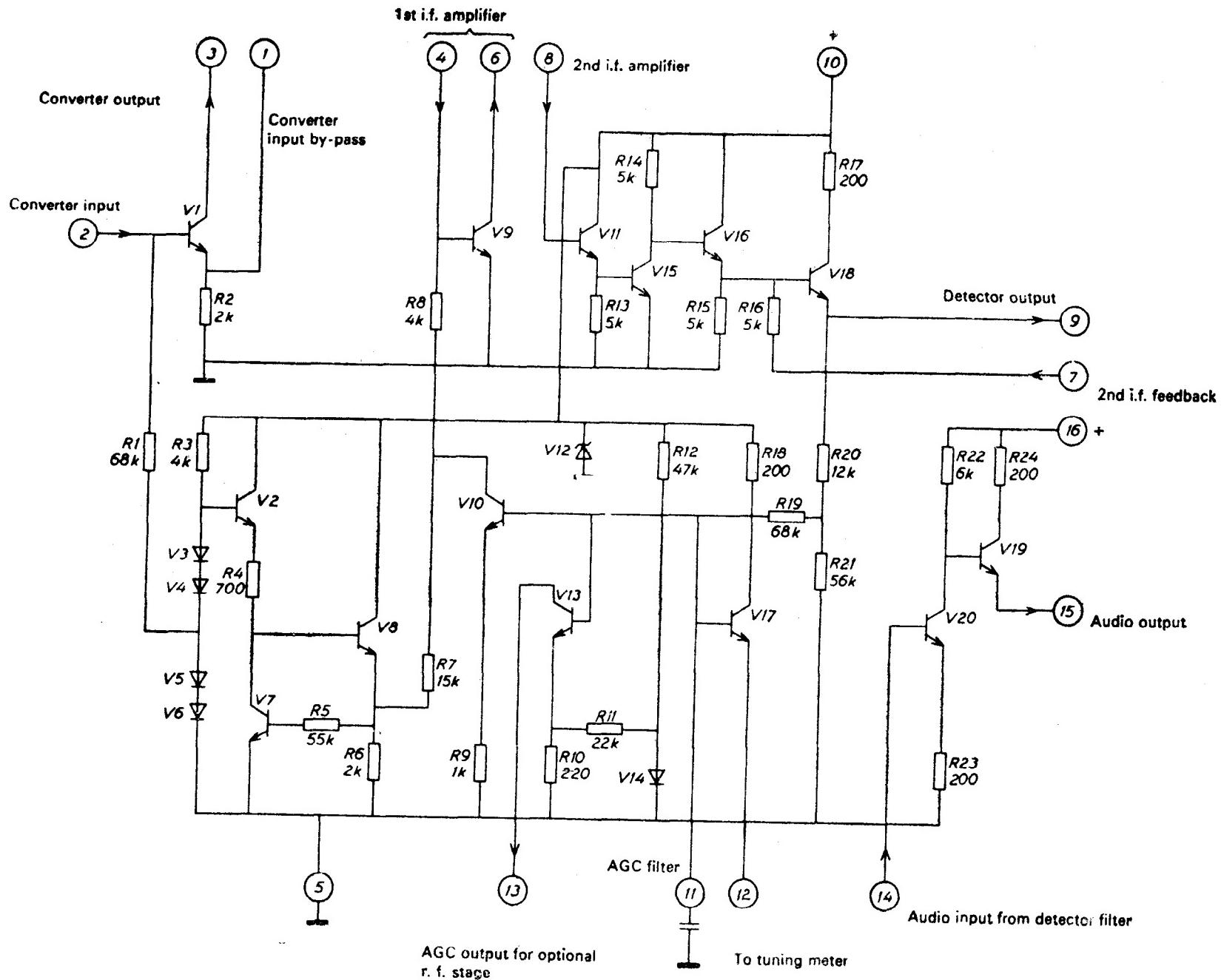
FIG. 46 REPEATING SYMBOLS

Capacitors	C_1/C_2		C_4	C_6		C_5		C_7								
Resistors	R_1	R_2	R_3	R_4-R_6	R_{23}	R_8	R_9-R_{11}	R_{26}	R_{13}	R_{30}	$R_{14}-R_{16}$	R_{17}	R_{18}	R_{34}	R_{19}	R_{20}
Miscellaneous	V_1	V_2	V_3	V_{15}	R_{22}	R_7	$R_{24}-R_{25}$	$R_{27}-R_{28}$	R_{32}	R_{31}	R_{33}	R_{21}	R_{35}	V_{19}	V_8	K_1





48A Simplified Representation of Complete Circuit
FIG. 48 EXAMPLE OF AN AM BROADCAST RECEIVER — *Contd*



48B Detailed Representation of Unit A1
FIG. 48 EXAMPLE OF AN AM BROADCAST RECEIVER